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RESOURCE CONSERVATION AND DEVELOPMENT HANDBOOK

NEW MEXICO

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Range Improvement Practices Employed by the Bureau of Land Management in New Mexico

Four Bureau of Land Management districts within New Mexico administer approximately 12,000,000 acres of Federal land.

Each year thousands of these Federal acres are treated to improve vegetation, soil conditions, reduce erosion and as otherwise indicated to create an optimum condition for livestock and wildlife production, conservation and preservation of the public domain.

The following pages include a description of the various practices with photographs showing the various treatments, the equipment used, and the results.

This booklet was prepared primarily as a guide for planning various land treatment practices and to introduce individuals who are not familiar with these practices to the improvement possibilities on Federal and other lands.

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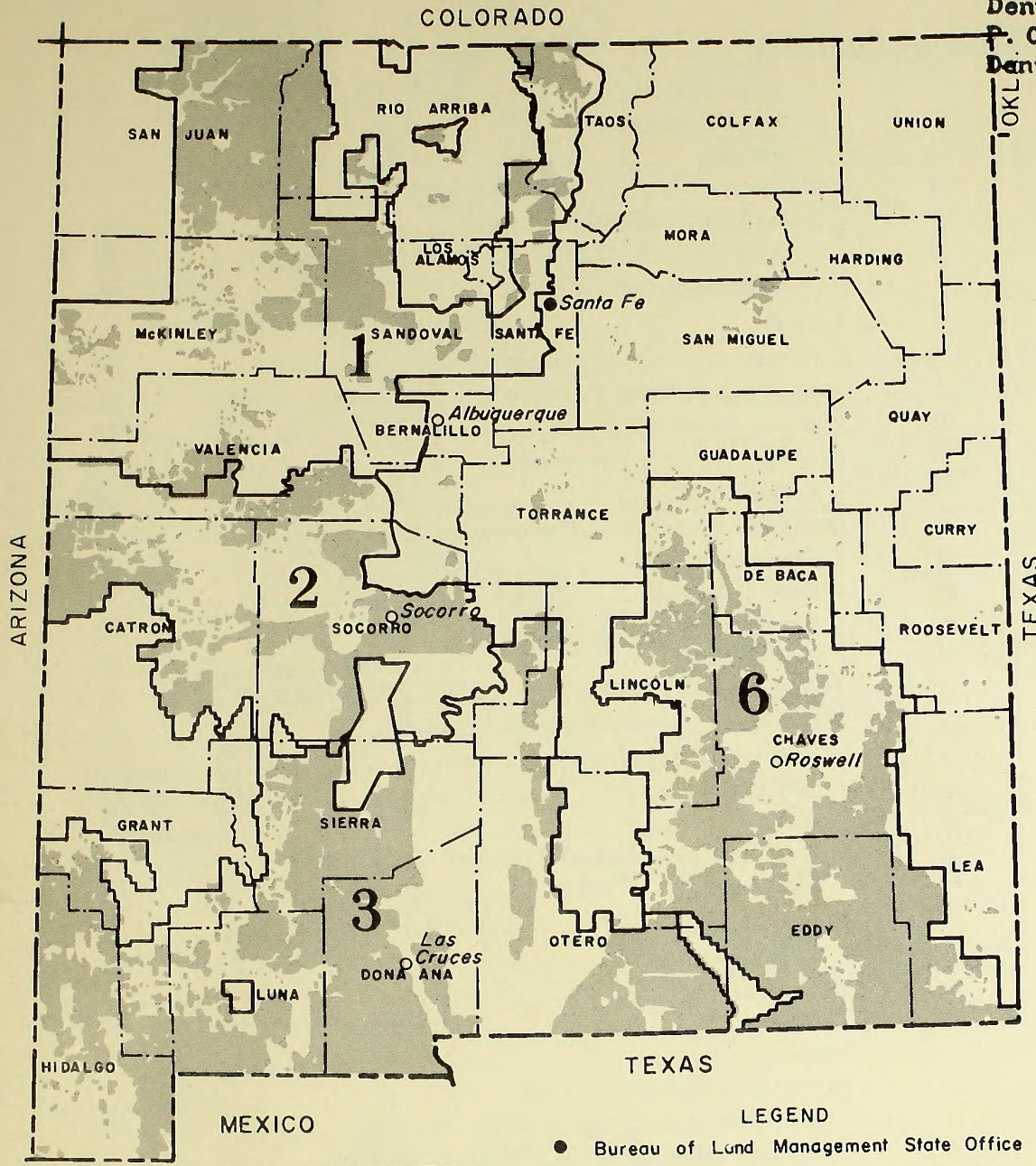

BLM DISTRICTS
IN
NEW MEXICO

LEGEND

- ● Bureau of Land Management State Office
- ○ Grazing District Office
- Grazing District Boundary
- Public Domain

CHECK LIST OF PRACTICES BY DISTRICTS

LAND TREATMENT PRACTICE	Albuquerque-Farmington NM 1	Socorro NM 2	Las Cruces NM 3	Roswell NM 6
BRUSH CONTROL				
MECHANICAL				
PINION-JUNIPER CONTRDL	X	X	X	
CHAINING	X	X	X	
MARDEN	X			
SAGEBRUSH	X			
PLOWING	X			
CHAINING	X			
MARDEN	X			
ROTARY CUTTING	X			
CREOSOTE			X	
MARDEN			X	
GRUBBING			X	
CACTUS		X	X	X
GRUBBING		X	X	X
BRUSH CONTRDL				
CHEMICAL				
PINON-JUNIPER			X	
DYBAR PELLETS			X	
SAGEBRUSH	X			
AERIAL SPRAYING	X			
CREOSOTE			X	
SPRAYING			X	
MESQUITE			X	X
SPRAYING				X
DYBAR			X	
SHINNERY OAK				X
SPRAYING				X
FENCING	X	X	X	X
CATTLE & SHEEP	X	X	X	X
STUDY PLOTS	X	X	X	X
SEEDING	X	X	X	X
GRASS	X	X	X	X
BROWSE	X	X	X	
OTHER SOIL				
STABILIZATION PRACTICES				
DEEP TILLAGE	X	X	X	X
WIRE CHECKS	X	X	X	
PEST CONTROL				
KANGARDO RATS	X	X	X	X
HARVESTER ANTS		X		
WATER DEVELOPMENT				
RESERVOIRS	X		X	
SPRING DEVELOPMENT	X			X
WELLS	X	X		
PIPELINES		X		X
WATER CONTROL				
DETENTIONS	X	X	X	
DIVERSIONS	X	X	X	
DIKES	X	X	X	X
BANK PROTECTION	X			
PROGRAM FACILITIES				
CATTLEGUARDS	X	X	X	X
FIRE PRESUPPRESION				
FIRE BREAKS			X	
ACCESS ROAD				
MAINTENANCE	X	X	X	

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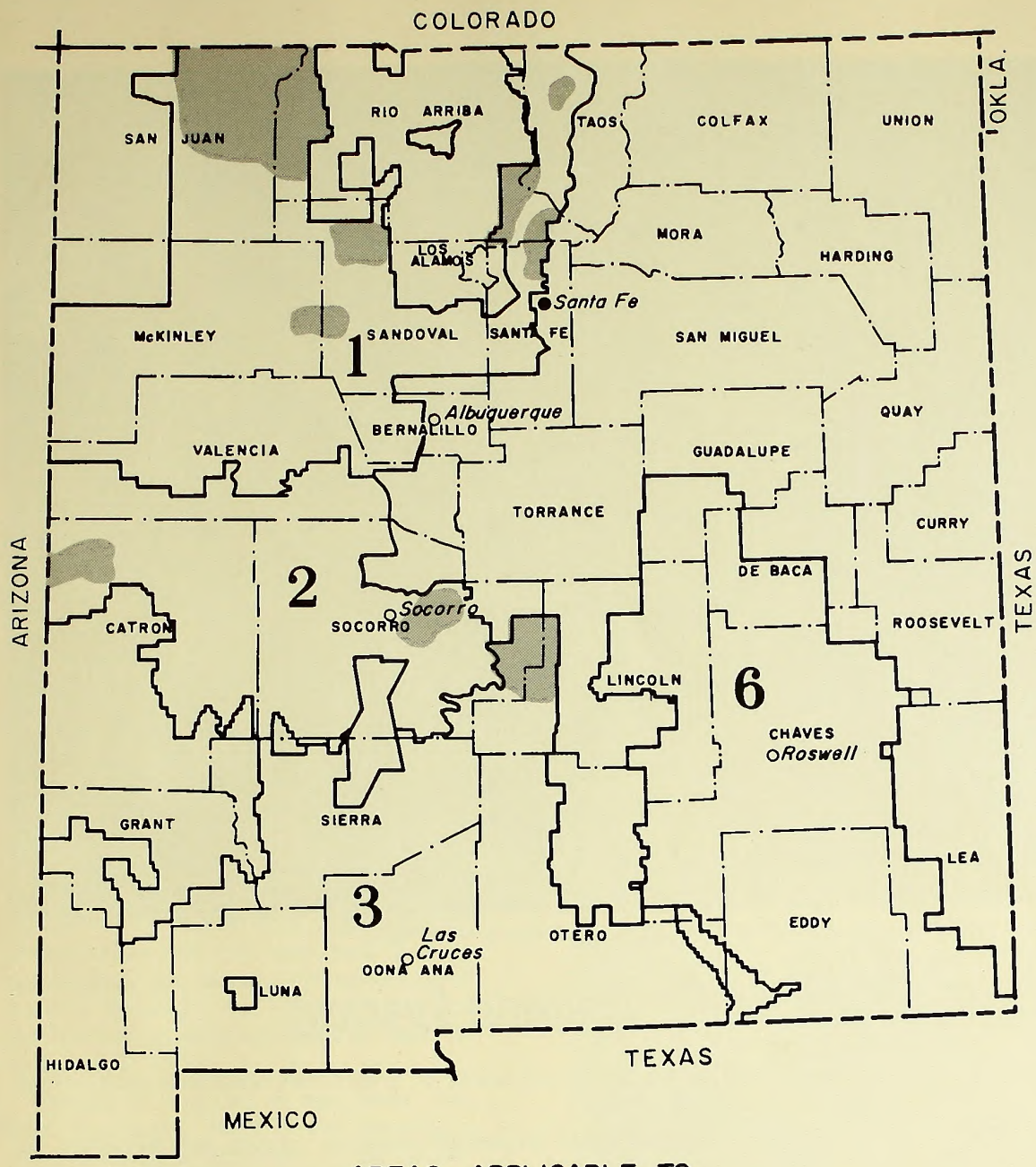


AREAS APPLICABLE TO
PIÑON—JUNIPER CONTROL

BRUSH CONTROL MECHANICAL

Includes the control or removal of dominant or undesirable brush species in order to replace them naturally with vegetation which is more useful, protective or erosive resistant.

Dense stands of pinon-juniper prohibits the existence and establishment of desirable forage producing plants

PINON-JUNIPER CONTROL *(Pinus Edulis- Juniperus Species)*

Thousands of acres of Federal land, as well as other lands, have been partially cleared of pinon, *Pinus edulis*, and juniper, *Juniperus species*. This has been a highly-effective practice in reducing competitive plant species, where this excess vegetation is a detriment to proper management for game and livestock. Desirable treatment sites are those areas where there exists a low density of a more desirable vegetation and high density of pinon and juniper. Also of primary importance is that the soils have good depth and the topography is rolling to flat with mesa tops or benches. Undesirable sites would have broken topography with steep slopes, shallow soils with underlying or exposed area of sandstone and shale, or poorly developed soils with numerous surface rock fragments.

Soil erosion, watershed protection, livestock, wildlife, and recreation potential are the major considerations to be taken prior to chaining.

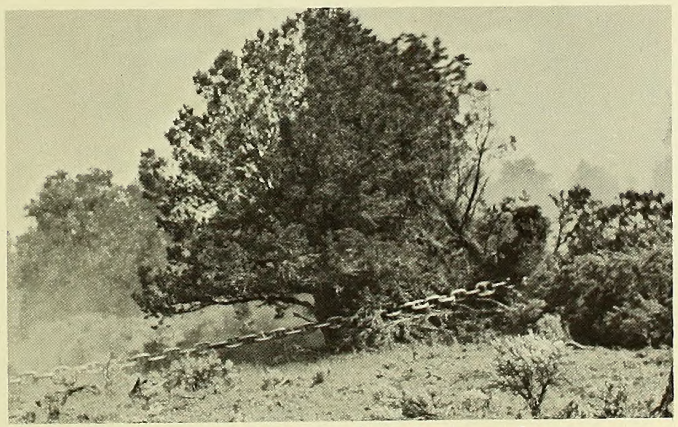
Purpose: The main purpose of controlling pinon and juniper is to reduce the competition for moisture between the brush and grasses. The desired result is to obtain an increase in forage production and thereby guarantee soil stabilization and related benefits.

PINON-JUNIPER CHAINING

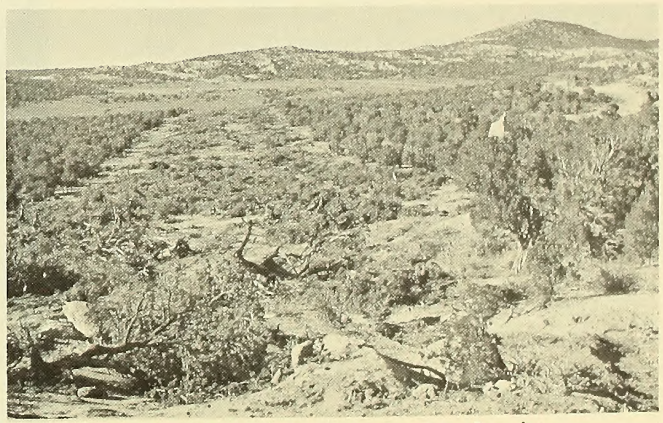
Description: The control consists of pulling a chain or cable on the contour between two crawler-type tractors with a minimum of 155 drawbar horsepower. These tractors pull an anchor chain up to 600 feet in length and weighing 35 pounds or more per foot. The distance between the tractors while chaining varies between 100 to 300 feet depending on the size and density of the brush and the terrain of the area. The two tractors act as one unit, one on each end of the chain. The tractors are generally operated parallel to each other. The operation is not carried on when the ground is frozen, extremely wet, or covered with snow. Reasonable care must be taken in conducting the work to prevent unnecessary disturbance of the area as well as survey corners, Indian ruins and strategic game cover strips. This type of work is accomplished under contract and usually costs from $2.50 to $3.50 per acre depending on terrain, size and scattering of the areas to be cleared, etc. Where adaptable within the State, reseeding is combined with this practice. Broadcast seeding has been used in some cases before the chaining operation as well as after chaining. (See Seeding for further information on reseeding methods used, results, etc.)

Results of chaining in the State have been very good. Most of our chaining is done on stands of large mature trees. Chaining has been very effective in uprooting these large trees. Big game habitat must receive more consideration in application of this treatment than with some of the other treatments because chaining sites are the more favorable locations for game habitat.

An area cleared of pinon-juniper against an uncleared area



The 20,000 pound chain at work

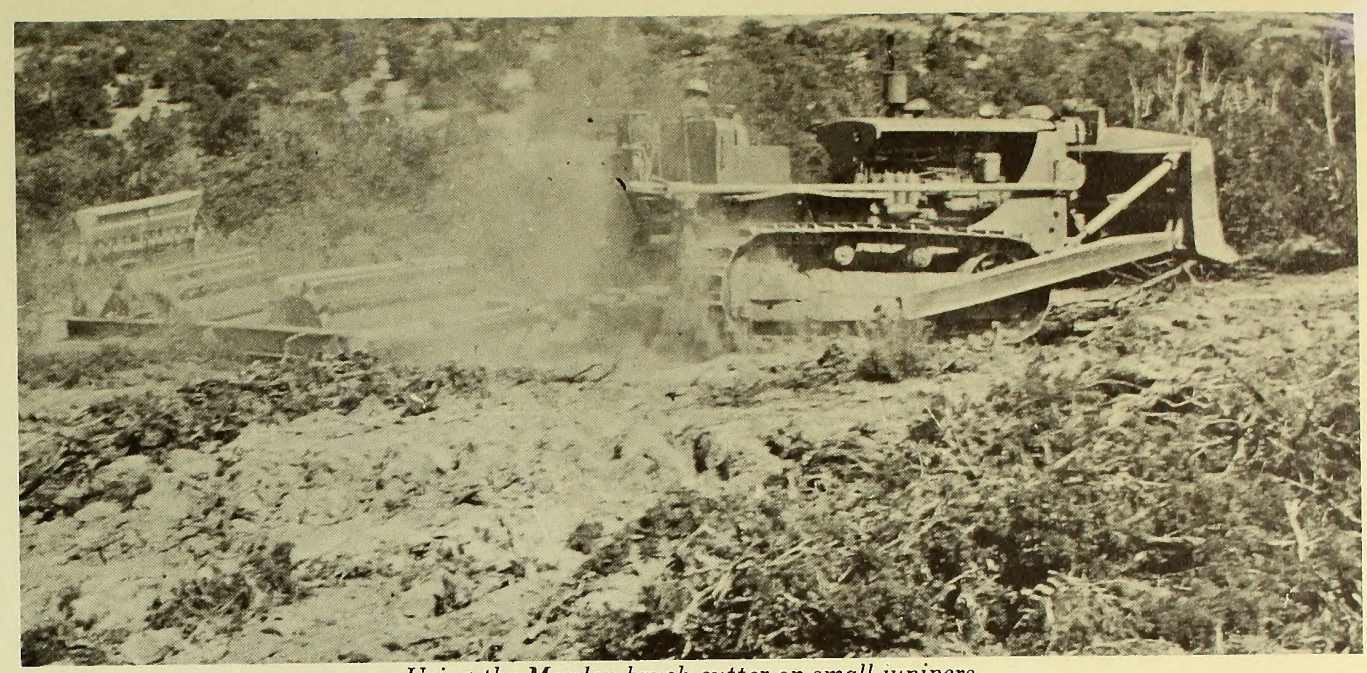


Strip clearing of pinon-juniper leaving wildlife and game habitat

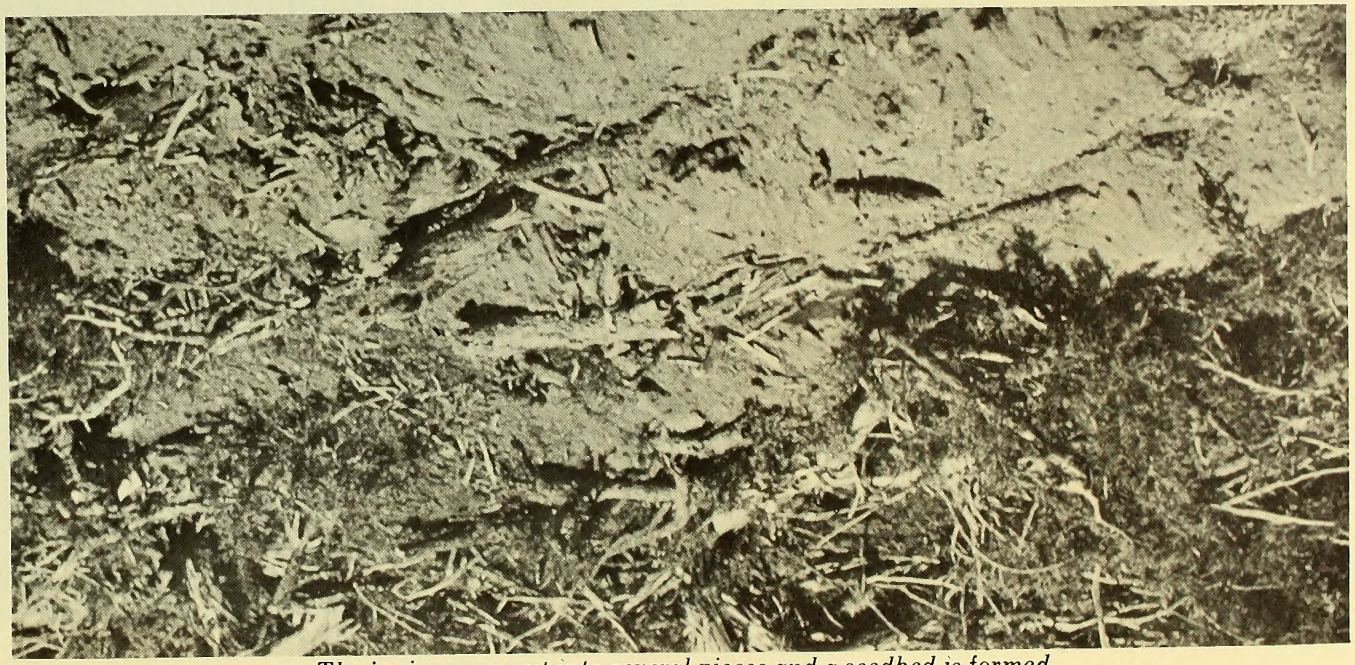
USE OF MARDEN BRUSH CUTTER ON PINON-JUNIPER

The Marden Brush Cutter (See Brush Control - Mechanical - Sagebrush - Marden Brush Cutting, for description of equipment) has been used also on pinon and juniper. As a general rule, it is used primarily on scrub trees less than eight feet in height and scattered. A 70% to 80% kill has been accomplished on some areas but due to the size restriction, etc., the use of the Marden Brush Cutter on pinon and juniper is a selective type of treatment.

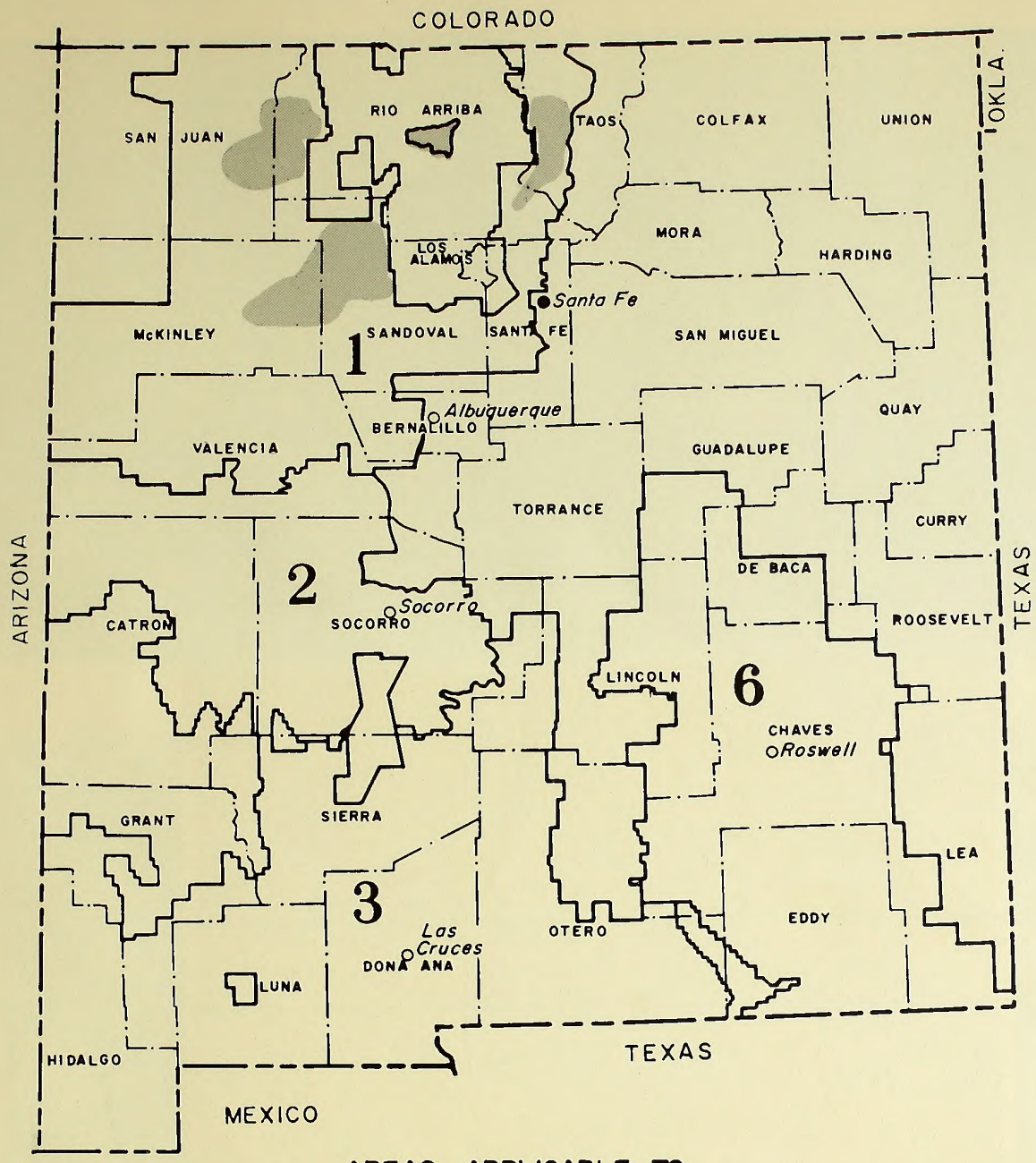
Requirement: Deferment is required with this practice and a more detailed deferment plan is required if seeding is included. Similar objectives which directly benefit Federal land is the application of "Dybar" to resprouting or regrowth of pinon or juniper. "Dybar" (See Brush Control - Chemicals - Pinon-Juniper Control) is effective in killing pinon and juniper plants, but is not used on large dense stands due to the cost.



Using the Marden brush cutter on small junipers



The junipers are cut into several pieces and a seedbed is formed



AREAS APPLICABLE TO SAGEBRUSH CONTROL

SAGEBRUSH CONTROL

(Artemisia Species)

SAGEBRUSH CONTROL (Continued)

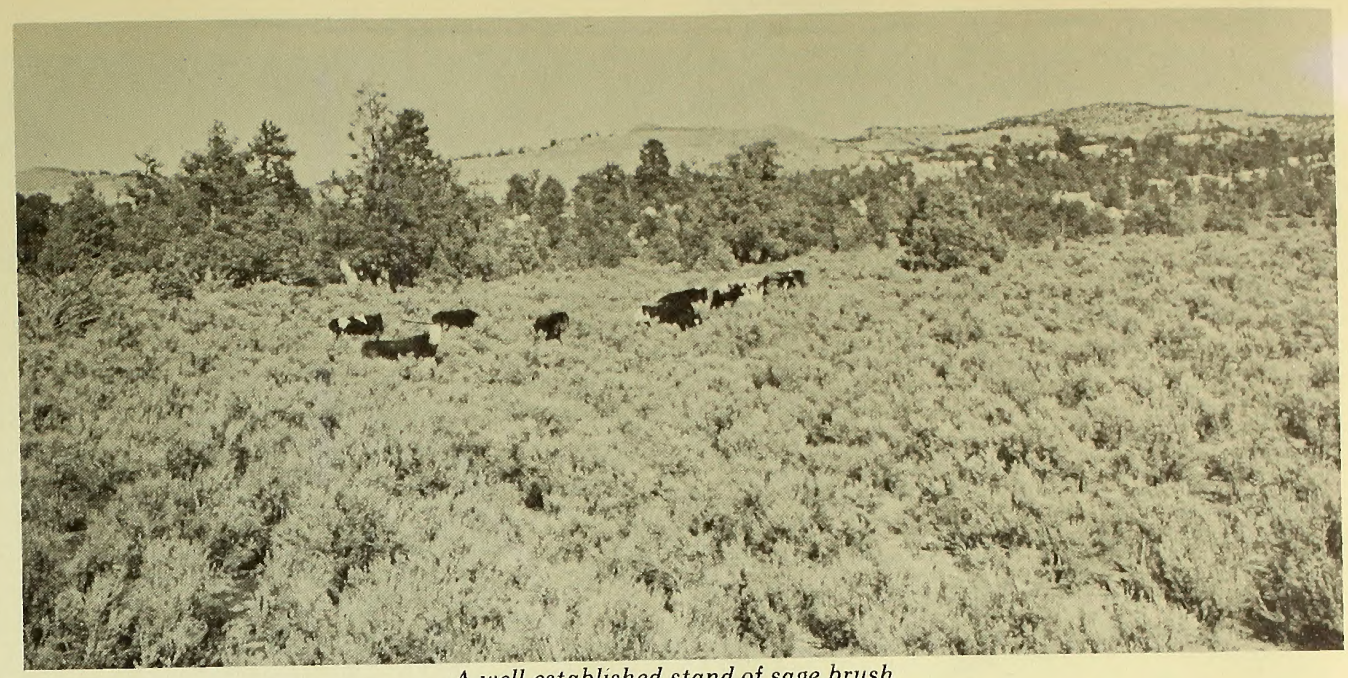
Sagebrush control brings about major increases in grass production on millions of acres of western ranges. Controlling competing sagebrush and restoring the site to a good stand of grass (forage) plants through natural or artificial seeding enables reduction of erosion, watershed protection, upland game bird feed as well as added forage for cattle and sheep.

Desirable sites for this practice consist of a stand of sagebrush largely in one age-size class with a fair understory of perennial grasses. Sagebrush should be of sufficient height and age to have acquired a semi-woody characteristic and not have the herbaceous character which allows younger sagebrush to bend and let the chain slide over it when the chaining practice is used. Absence of an understory of perennial native grasses indicates that reseeding is needed to achieve desirable plant cover. Areas having a low to medium density of cactus (*Opuntia species)* should not be treated as the practice will increase the density of this undesirable plant due to spreading with the chain.

Purpose: In tall dense stands, sagebrush is undesirable. It is relatively unpalatable to cattle and sheep and it uses moisture and soil nutrients that should be producing grass or desirable forbs. It hampers movement of livestock, especially sheep. The heavy brush provides ideal cover for predators such as coyotes.

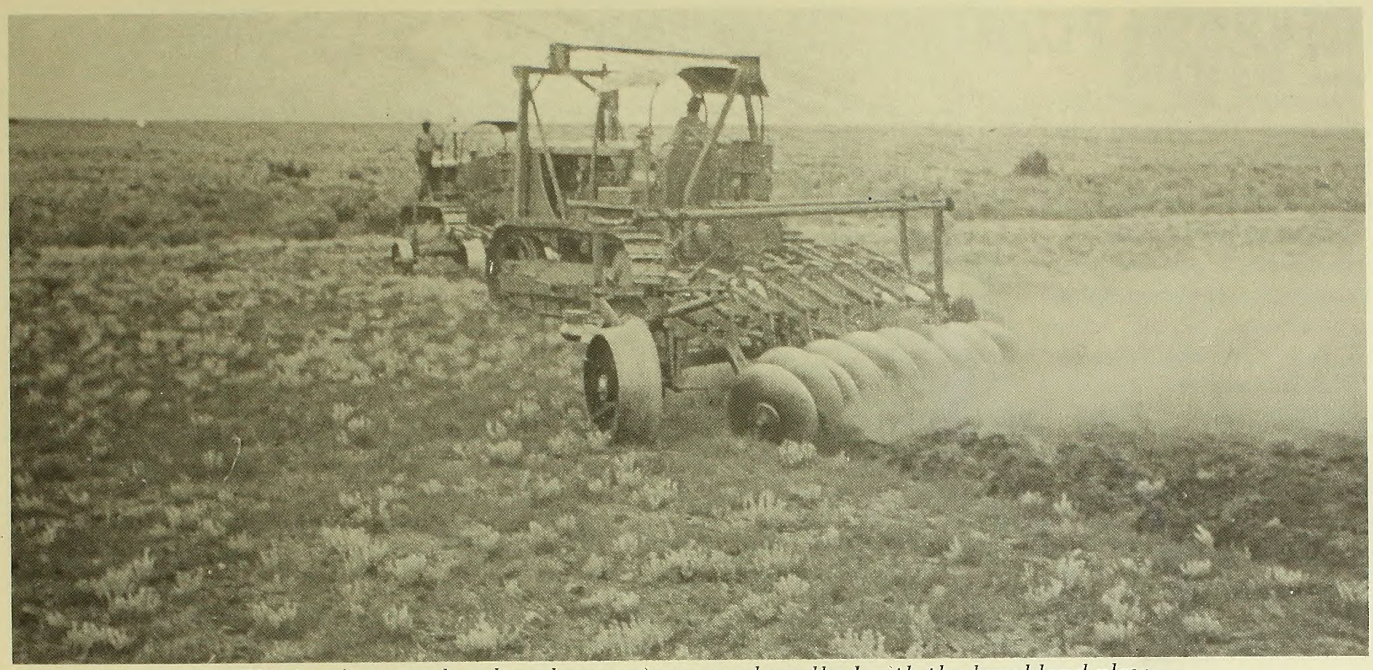
As a result of the increase of sagebrush, western ranges now support fewer livestock than the land has a potential for.

Description: Several different types of treatment have been used to control sagebrush. These include plowing, cutting or chopping, chaining and aerial spraying. (See Brush Control - Chemical - Sagebrush Aerial Spraying.)



A well established stand of sage brush

Removal of the sage produces good results



Eliminating sage brush and preparing a good seedbed with the brushland plow

The brushland plow with a seeder attachment

SAGEBRUSH PLOWING

Sagebrush plowing has been used to control sagebrush and provide a seed bed for crested wheatgrass, *(Agropyron cristatum)*. Plowing has usually been with a one-way or "wheatland plow" with the seeding done by broadcast seeders attached to the plow.

Many areas have low amounts of desirable grass (forage) plants and reseeding is necessary. Brush should be of a size and height that the plow can handle. Areas should be relatively free of rock outcrops or surface rocks. Slopes should be moderate with soil depth and a salt free type of soil which will permit response to this treatment. Plowing on contour lines is required so far as practicable.

The plows are usually at least ten feet wide with the discs mounted on a solid axle, or of the Brushland type with discs mounted on a single arm suspension. Discs have a minimum diameter of 26 inches. These plows are pulled by small crawler-type tractors or by large heavy-duty wheel-type tractors.

When plowed, the soil is broken up and becomes aereated. This results in greater absorption of water and a good seed bed preparation as well as the removal of brush. Plowing is generally done at a depth of three to six inches, which usually provides a satisfactory kill of brush.

Seeding can be done in connection with plowing. Seed boxes are usually mounted on the plow and seed is broadcast by vibration on the ground behind the plow. Packer wheels are generally attached to the plow and compress the seed bed.

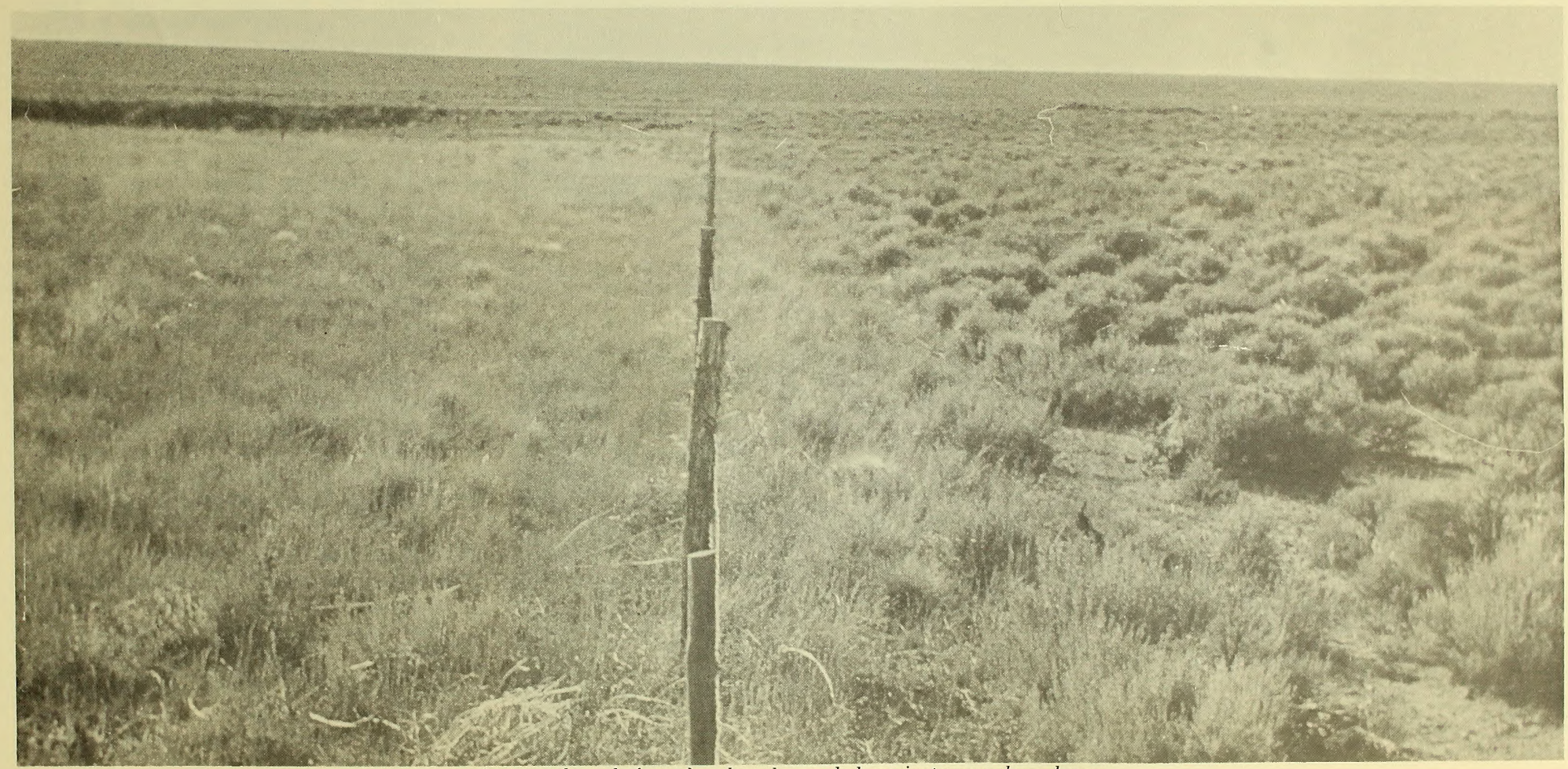
SAGEBRUSH PLOWING (Continued)

In some instances, seeding is done by pulling a Rangeland drill over the ground either immediately after plowing or at some later date. The best results are received by seeding during or immediately after plowing.

The success of plowing appears to depend more on climatic conditions than does treatment with the Marden Brush Cutter. Given sufficient moisture at the proper time, plowing can be very successful. However, a greater percentage of successes have been obtained using the brush cutter rather than the plow.

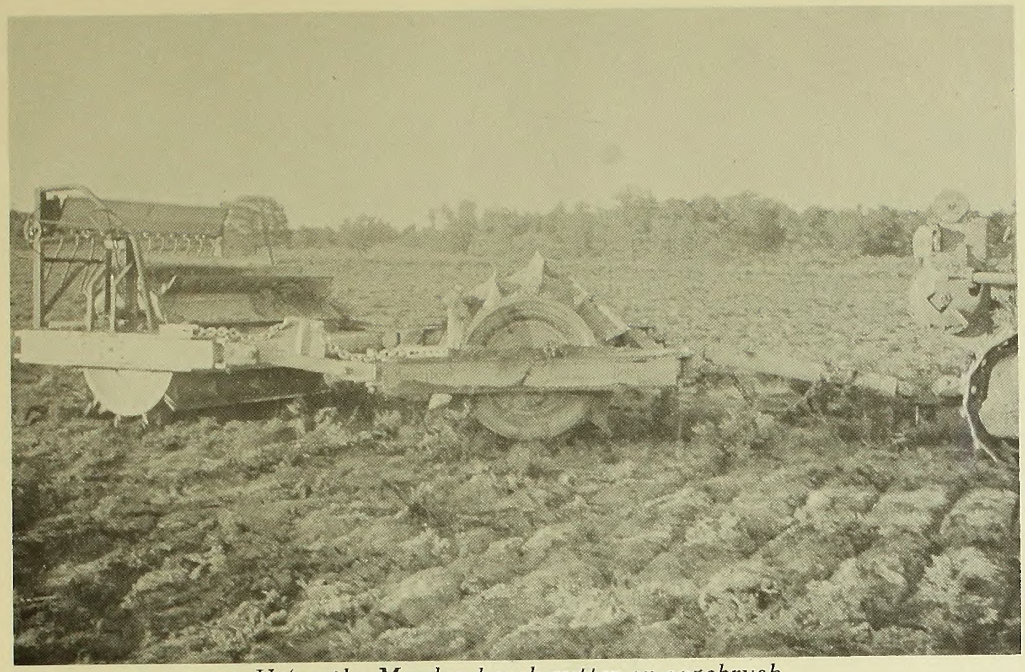
Power to pull the plow with broadcast seeder and packer wheels will cost from $3.50 to $4.50 per acre. Power to pull the plow and rangeland drill seeder to do the work in one or two operations will cost from $4.00 to $5.00 per acre.

Results of plowing and seeding projects have been good and the program is expected to continue.



An area cleared of sagebrush and reseeded, against an uncleared area

USE OF MARDEN BRUSH CUTTER ON SAGEBRUSH



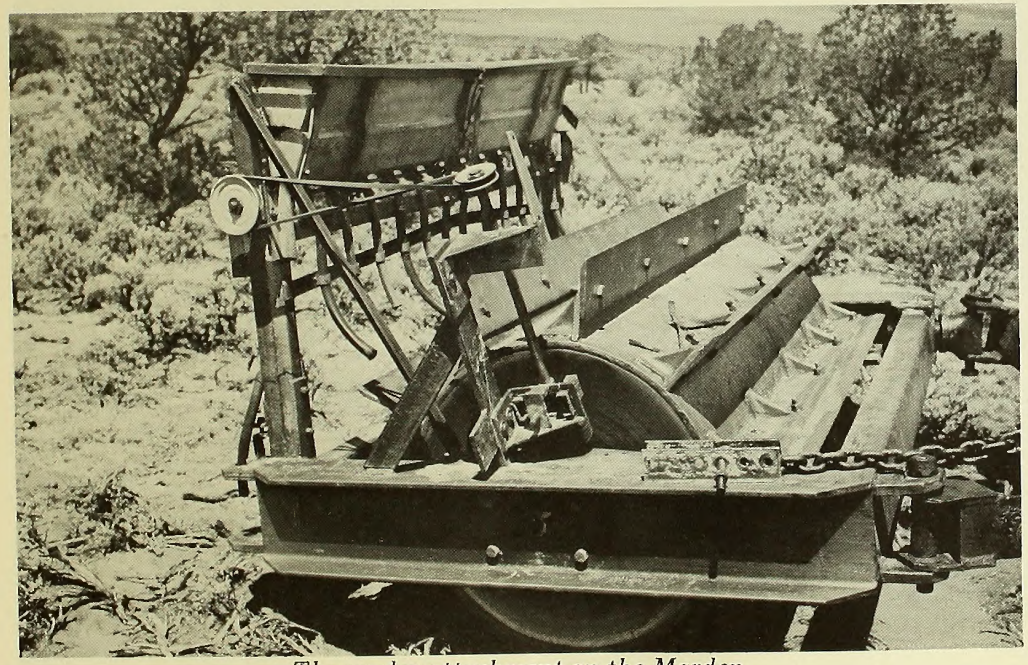
Using the Marden brush cutter on sagebrush

There is an increase in the available forage for livestock and game developed by this practice and this has made it possible for operators to maintain their present numbers of livestock where removal was considered necessary.

Generally the results from using the brush cutter have been good. Control of sagebrush has ranged from a high of almost 100 per cent to 70 or 75 per cent. The best results are received on areas where the sagebrush plants are tall and mature. Young stands of sagebrush are very small low-growing plants and have not reacted as favorably to treatment.

The Marden Brush Cutter is a machine designed to clear brush by chopping and can be equipped to plant seed.

The brush cutter consists of two drums with 10-inch cutting blades horizontally attached. Cost of the two cutters runs from $12,000 to $14,000. The drums are usually filled with diesel oil to provide the necessary weight and are pulled with a D-8 Caterpillar-tractor or equivalent. The drums are offset from each other at about a 30° angle and are arranged so the rear blades cut the



The seeder attachment on the Marden

The Marden brush cutter prepares a desirable seedbed

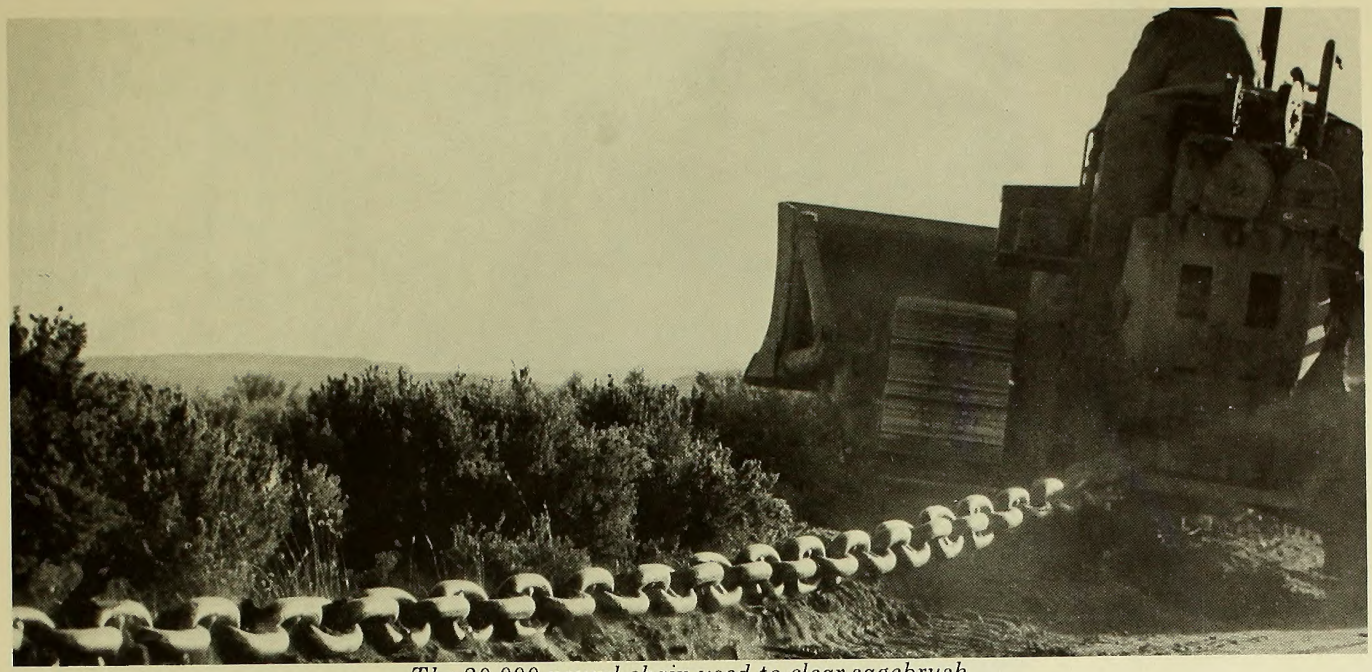
The Marden at work on sagebrush

USE OF MARDEN BRUSH CUTTER (Continued)

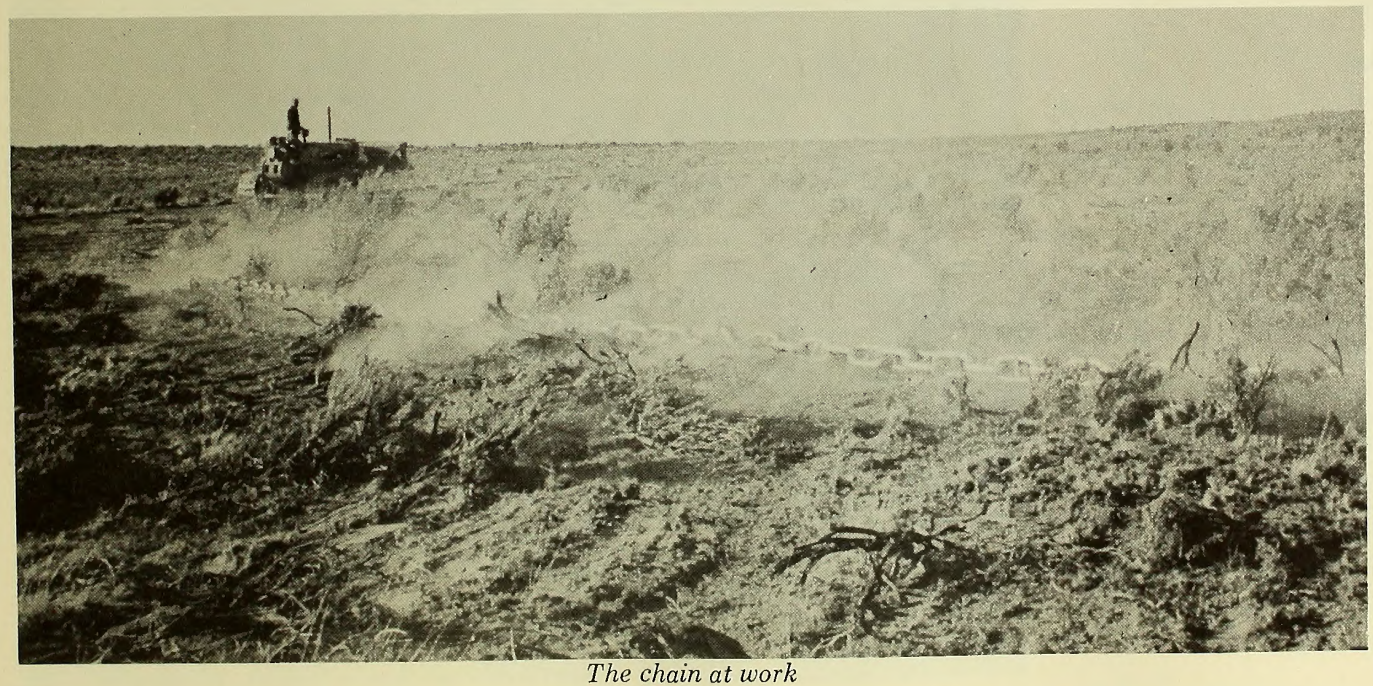
area left uncut between the front blades. A seeder is usually mounted on the pulling frame at the back of the rear drum. The per acre cost for brush cutting usually runs from $6.00 to $7.00, which is the cost for the power to pull the cutters.

This is usually done under contract, and some districts have their own cutters and contract only for the power.

The brush cutter makes horizontal pits in the ground and serve a multiple purpose, namely, a bed for the seed which falls into the pits or as a catch basin which is covered with a layer of wet soil after rains. This results in an excellent seed bed and covering for seed. The most important purpose these pits serve is to hold water during heavy rains forming a small dam that prevents runoff that would otherwise be lost. The cutters should be pulled normal to the slope so that the pits are on the contour.



The 20,000 pound chain used to clear sagebrush



The chain at work

SAGEBRUSH CHAINING

Sagebrush chaining, very similar to pinon-juniper chaining, has been practiced with success in certain areas. The chain is 300 to 600 feet long and weighs from 35 to 40 pounds per foot. The work is contracted and the bidder required to furnish two crawler type tractors with not less than 155 drawbar horsepower rating. The chaining operation is the same as that used in pinon-juniper control.

Timeliness in performing the work is the most important factor in obtaining success of this treatment. The work must be done in the fall between the first good killing frost and before ground freeze-up or in the spring after the ground has thawed out but before plant sap has risen to give resilence to the plant stems. The success of sagebrush control by this method has been less effective when done at times of the year other than those above.

Total costs for sage chaining projects are estimated to range from $.80 to $1.50 per acre. The latter cost was estimated for a project area which contained a light to medium stand of pinon-juniper not extensive enough to merit a pinon-juniper chaining contract.

Sagebrush chaining has resulted in estimated eradication of 30 to 80 per cent of the sagebrush. A large number of areas in the northern half of the State are adapted to this practice and will be a continuing practice. Response of native grasses due to the lessening of competition for moisture and soil disturbance is apparent but measurements of forage production resulting from this practice have not been made.

ROTARY CUTTING SAGEBRUSH

A rotary-type brush cutter, primarily a John Deere Gyro Mower has had limited use, however, this practice appears to be excellent in reducing sagebrush. The brush is cut to ground level when conditions permit.

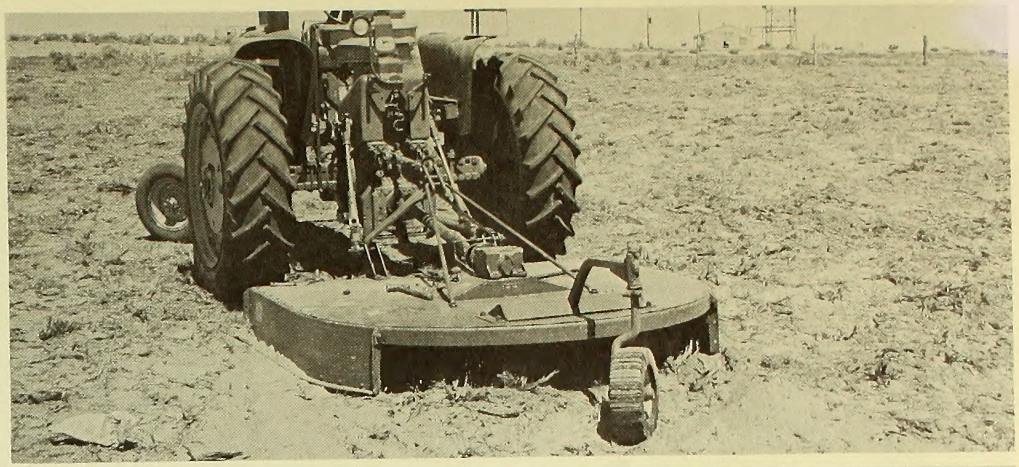
Desirable sites for use of this practice have sagebrush stands of 24 inches or more in height with the stand predominantly of the same age or size. Rough areas with surface rock or outcrops of rocks must be avoided. Eroded areas with pedestals because of wind or water erosion which may interfere with the cutting blades are also to be avoided.

The cutter can be pulled by a farm-type tractor which is limited to speeds not in excess of three miles per hour. The cost for this type of treatment with the contractor furnishing all equipment and materials is approximately $4.50 per acre.

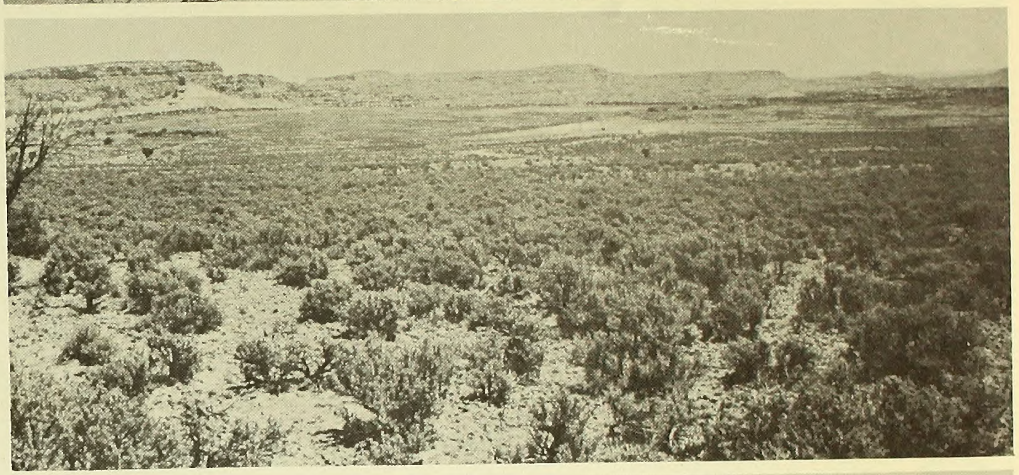
This type of brush eradication appears to be adapted to late spring and early summer. In future projects, this time schedule is expected to continue.

Projects completed in brush cutting in the summer of 1964 apparently resulted in a high rate of kill but total effect has yet to be determined. Response of the understory native perennial grasses is impressive on these projects. Areas which were originally planned for reseeding responded so well to the treatment that reseeding plans were cancelled.

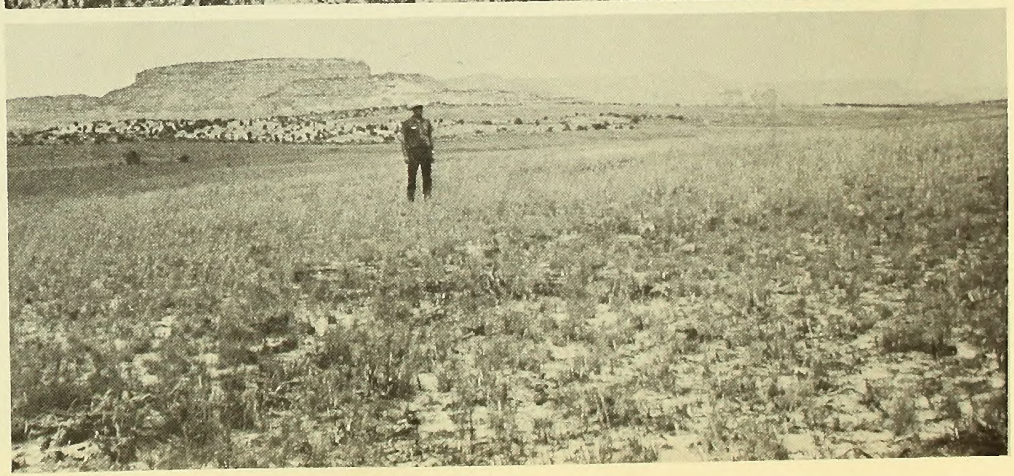
Considerable portions of the sagebrush areas in the northwestern part of the State are adapted to this practice and it is planned to continue the scheduling of future projects.



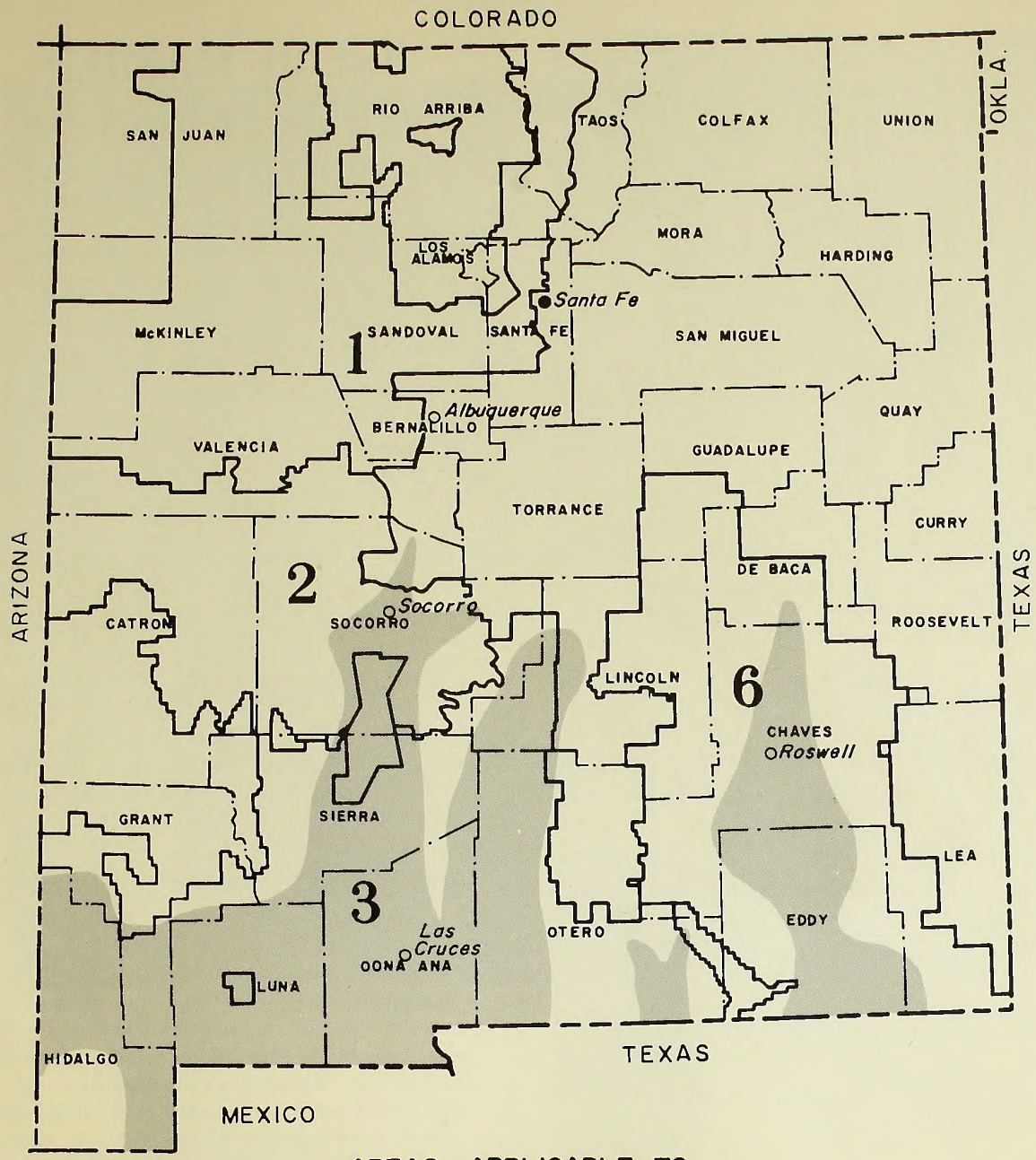
The rotary chopper



A typical stand of sagebrush ready for chopping



A good stand of grass is established after chopping



AREAS APPLICABLE TO
CREOSOTE BRUSH CONTROL

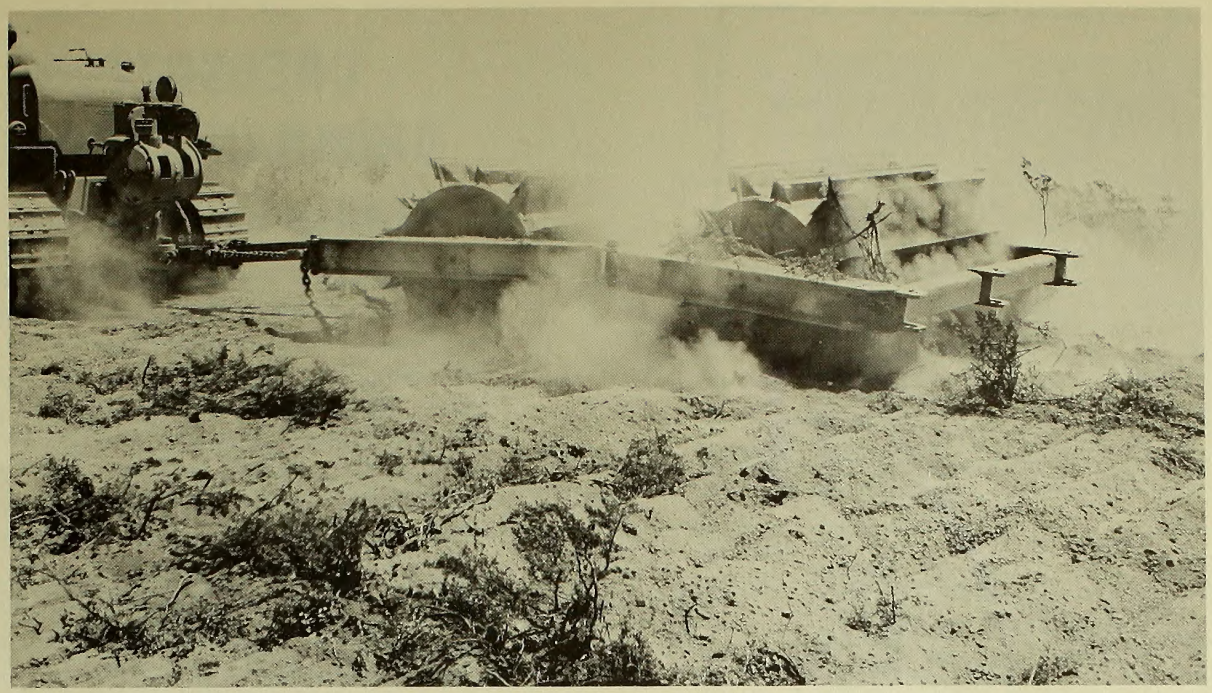
CREOSOTE BRUSH CONTROL
(Larrea Divaricata)

The existence and invasion of creosote brush, *Larrea divaricata* and tar bush, *Flourensia cernua*, on thousands of acres of rangeland have been a problem for many years. These species are unpalatable to livestock and may tend to crowd out more useful plants. Several agencies have conducted trials toward the control of this brush.

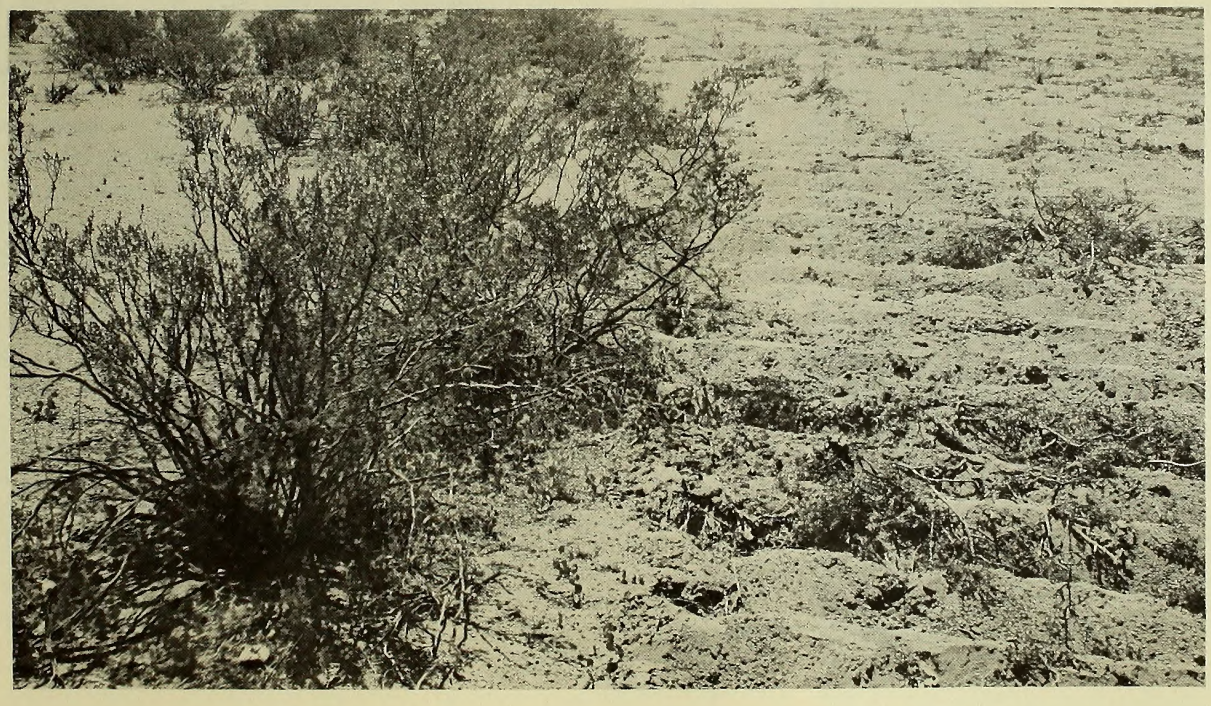
Purpose: Creosote brush and tar bush occupy many acres of rangeland which could be supporting forage producing plants. These undesirable brush species compete directly with desirable forage plants for sunshine, moisture, space, soil nutrients and other factors necessary for plant growth.

Description: Several types of treatments have been attempted on creosote brush and tar bush. These include chopping, spraying, (See Brush Control - Chemical - Creosote Spraying), plowing, and actual grubbing of individual plants.

Desirable sites for creosote control are those areas with moderately heavy soils. These sites are usually relatively level in topography and support anywhere from 50 to 300 plants per acre. It is also desirable to have a presence of desirable forage plants. Undesirable sites support no desirable forage plants and usually have a shallow gravelly soil.



The Marden brush cutter at work on creosote brush



A clear contrast between treated and untreated

USE OF MARDEN BRUSH CUTTER ON CREOSOTE BRUSH

Creosote Brush — Marden Brush Cutter

(*See Brush Control - Mechanical - Sagebrush - Marden Brush Cutter, for description of equipment.*)

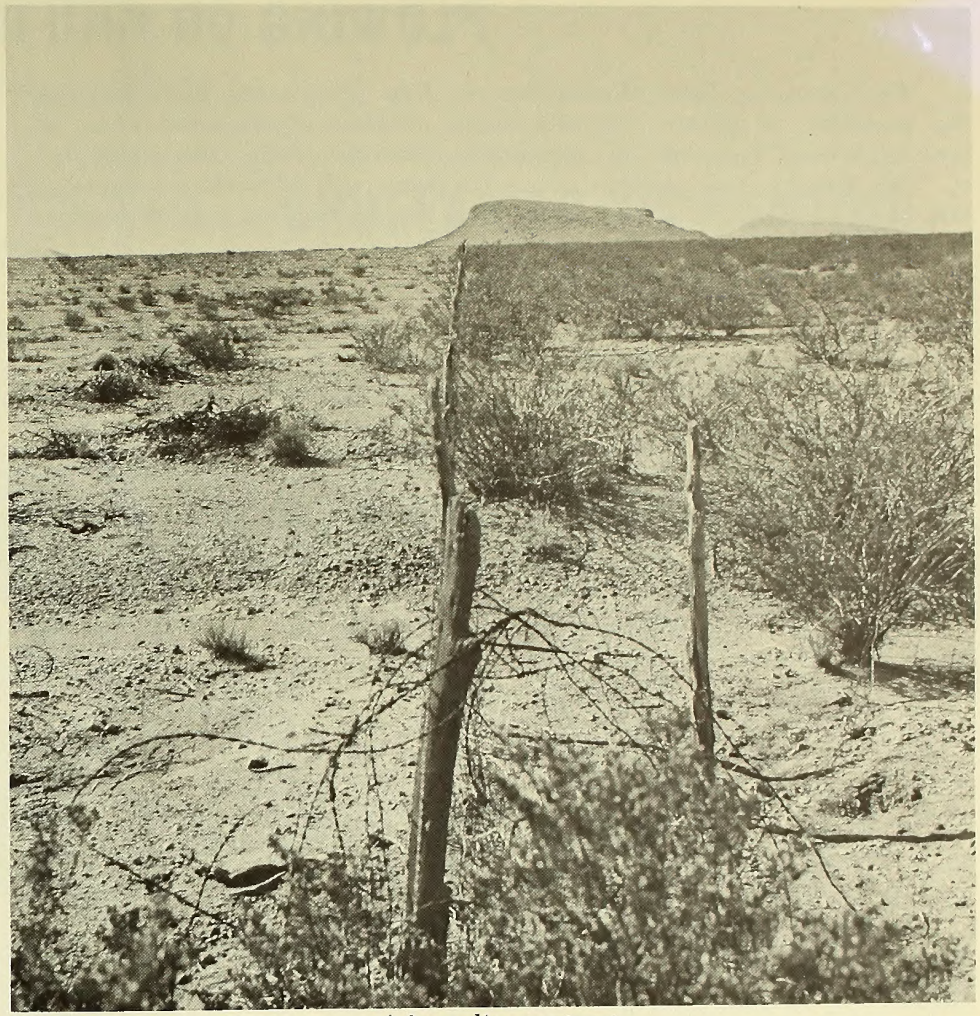
The use of the Marden Brush Cutter on creosote brush appears to be fairly satisfactory thus far. An approximate 200-acre plot was treated with the Marden Brush Cutter in the State in 1963. There has been some regrowth noted but it is not extensive. Future inspections are to be made before a complete evaluation is made. Costs for power to pull the cutter range from $6.00 to $7.00 per acre.

It is recommended that all work done with the Marden Brush Cutter be done in such a manner as to leave the rows or pits, left by the cutter, on the contour. This will greatly assist the project in reducing runoff and controlling erosion.

Creosote Brush — Rotary Chopping

A Servis Rotary-Type Brush Chopper, similar to the rotary chopper used on sagebrush (See Mechanical Brush Control — Sagebrush-Rotary Cutting) was used as a trial for control of creosote brush. The brush was chopped as close to the ground surface as possible. These trials showed that creosote brush must be severed well below the ground level to prevent the plant from coming back. Above ground level trials were failures.

A well grubbed creosote plant



A fence line contrast

GRUBBING OF CREOSOTE BRUSH

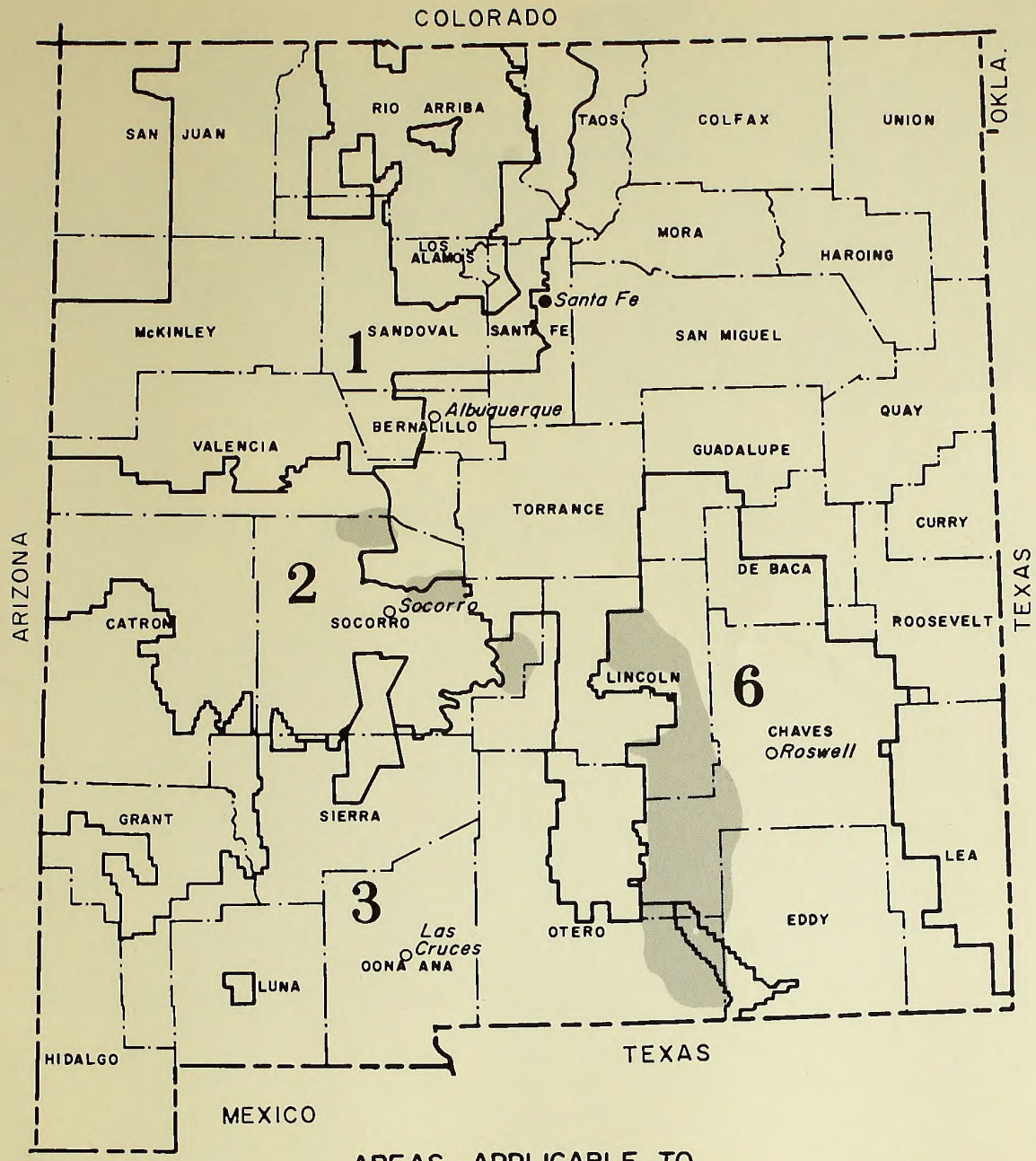
A farm-type tractor with a grubbing blade mounted on a hydraulic lift has been used to grub individual creosote plants. (See Brush Control Mechanical-Cholla Cactus Control for description of machinery.) The plants were grubbed at a depth of at least three inches and in some cases more. The plants were moved a sufficient distance to assure that none of the grubbed plant remained attached to the ground roots. In some cases roots were pulled out with the plant. The pit or indentation which remained after the grubbing served as an excellent catchment for seed and water. This also aided in controlling erosion. The only creosote grubbing project done by the Bureau of Land Management was completed in 1964, and it appears to be one of the better eradication practices for creosote brush. The cost for grubbing individual plants runs from $5.00 to $7.00 per acre, depending on number of plants per acre, size of plants, etc. Kills appear to be as high as 90 per cent.

PLOWING OR KNIFING CREOSOTE BRUSH

The Bureau of Land Management in New Mexico has been exploring the possibility of plowing creosote brush. Several experimental areas on privately-owned lands done by individual ranchers have been observed regularly. This practice, like grubbing, severs the plants well below the ground level, and a 100 per cent kill is not hard to find. Project costs are high, as much as $10 per acre.

Requirement: Grazing deferment is required with brush control practices to allow for the establishment of desirable grasses. A deferment plan is required if reseeding is to be done in connection with brush control. This also necessitates the construction of protection fences. (See Fencing.)

Creosote brush completely eliminated by plowing



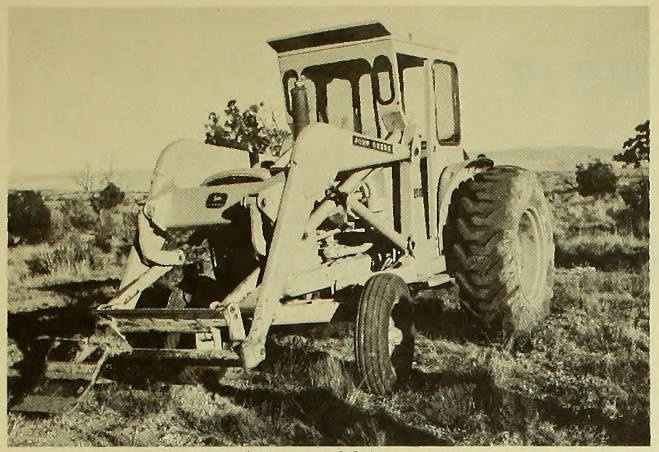
AREAS APPLICABLE TO
CHOLLA CACTUS CONTROL

CHOLLA CACTUS CONTROL
(Opuntia Species)

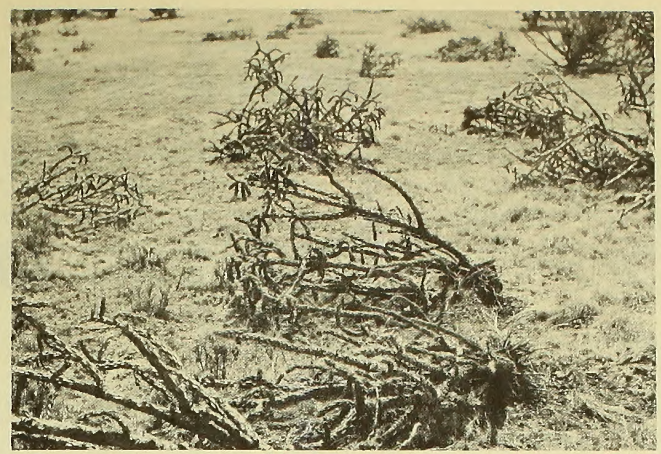
Cholla cactus *(Opuntia Species)* control is proving to be a very successful practice in eliminating an undesirable plant species in selected areas, for the purpose described below.

Purpose: The purpose for eliminating and controlling cholla cactus is primarily to provide more soil moisture, soil nutrients, sunshine, and space for desirable forage producing plants. Cholla cactus is considered to be a fast invader and has been known to completely take over an area in a period of a few years. The cholla cactus is also a hinderance in the handling of livestock, particularly sheep and goats.

Description: Cholla cactus control thus far has been limited to grubbing and spraying. (See Brush Control - Chemical - Cholla Cactus Spraying.)

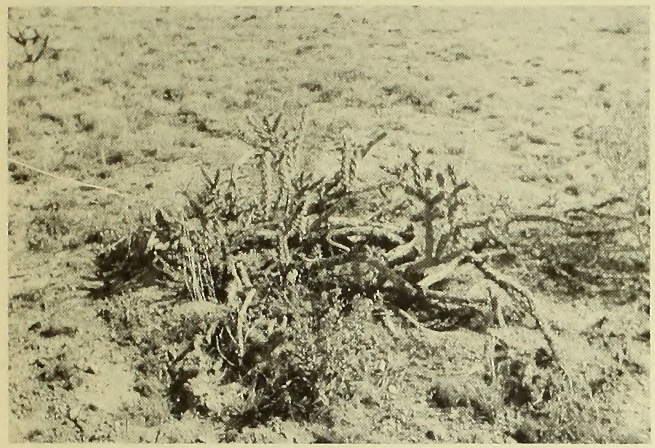


A tool for grubbing cactus



A grubbed cactus stand

Stacking the grubbed plants



Grubbing is not enough — plant must be moved

A moderate stand of cactus ready for treatment

GRUBBING OF CHOLLA CACTUS

Cholla cactus plants are individually grubbed with essentially the same type of equipment used in grubbing creosote brush. A regular farm-type tractor with a grubbing blade mounted on a hydraulic lift is used to accomplish the grubbing operation.

The work is done in two phases, (1) grubbing and (2) stacking. The grubbing consists of the severance of the main cactus stem at least three inches below ground level and removal of the plant from the grubbed hole.

The stacking is done no sooner than two months, or later than eight months after grubbing. All plants and parts of plants are stacked. The cholla plant must be removed from the grubbed hole, allowed to dry and then stacked to prevent any reproduction. The reason for this is because the cholla plant has many cylindrical joints, each of which is capable of producing a new plant. This is the main reason chaining cannot be used for control purposes.

This kind of work is confined to certain applicable areas supporting moderate to heavy stands of the cactus. Extremely rocky soils or steep and rough terrain will inhibit this type of work. The most desirable areas are those in which the soil contains no large rocks or boulders and a terrain which will alllow a tractor easy maneuverability.

The work is done on a contract basis and the cost per acre has been approximately $5.00. The southern part of the State is the only part in which this type of work has been done.

Some chained juniper plants will come back

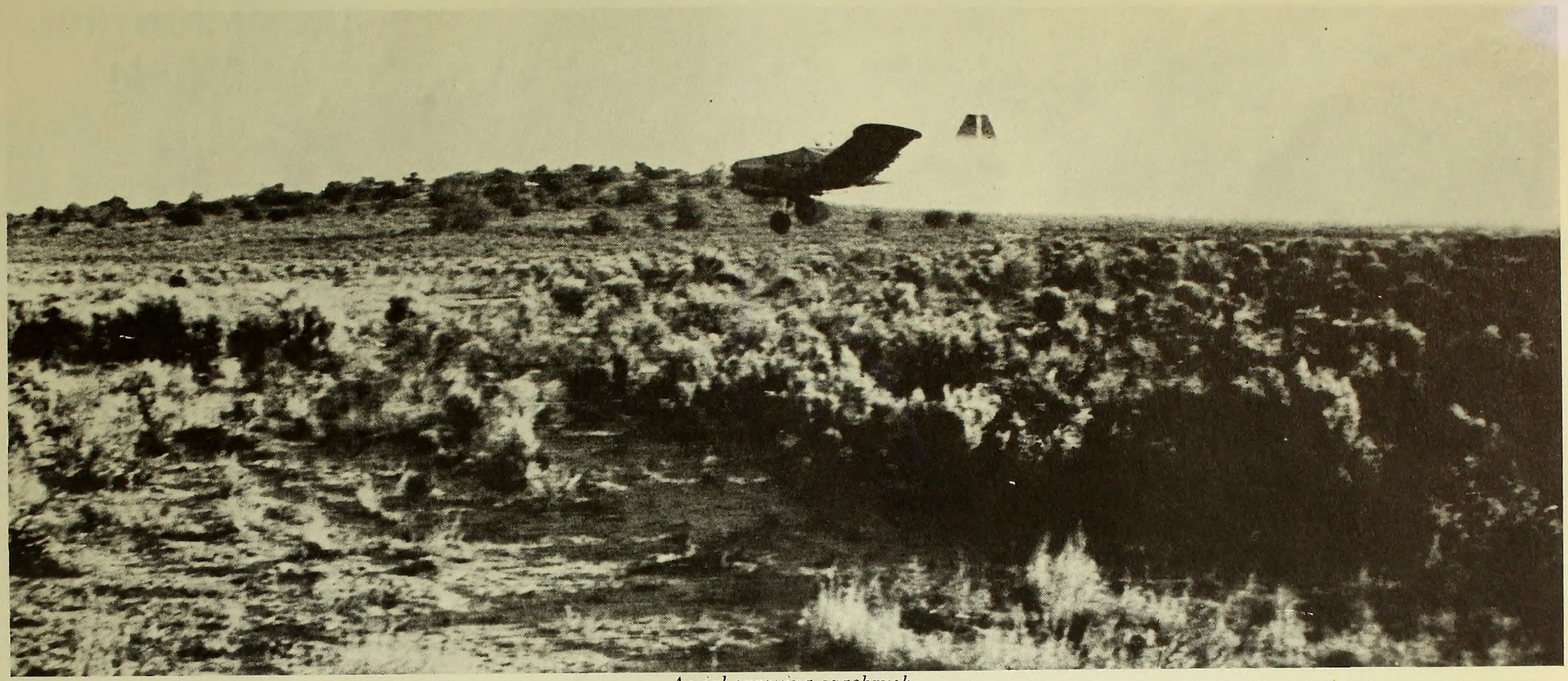
BRUSH CONTROL CHEMICAL

Pinon-Juniper — Spraying

At present there is no spray chemical which can be recommended for widespread use in a chemical control program for pinon and juniper. Foliage applications of 2,4-D or 2,4,5-T and combinations of the two have given good kills, but high concentrations and high volumes are necessary, which renders the treatment economically unfeasible.

Pinon-Juniper "Dybar" Fenuron Pellets

The application of "Dybar" pellets to a small stand of pinon juniper was completed in the southern part of the State in 1960. The rate of application was 1-2 tablespoons applied by hand at the base of the trees for every 6′ height, depending on soil structure. A heavy soil required two tablespoons, a light soil required one. After the first rainy season the trees began to lose their foliage and appeared to be dead. Because "Dybar" requires two to three rainy seasons to completely kill the plant the project could not be evaluated at that time. Later inspections were made and some regrowth was noted. The cost for material and application is high on dense stands of trees and the application to every tree is difficult. Because of this, the future for Dybar in pinon and juniper control appears to be limited to the application on pinon and juniper regrowths occurring in a chained or cut area.



Aerial spraying sagebrush

AERIAL SPRAYING OF SAGEBRUSH

Two aerial sage spraying projects have been completed in the northwestern part of the State. The first, done in 1957 was abandoned as a failure in 1959. The second done in 1964 has not gone long enough after spraying to be evaluated.

Desirable areas are flat to rolling with little or no broken topography. Density of sage brush should be high and an understory of native perennial grasses should be present. Areas must be far enough from row or field crops so that drift of chemicals by the wind will not damage them. Landing strips close by assist in keeping costs down. Areas of low desirability have broken to rough topography, low density of brush species, absence of perennial grass understory and distant landing strips.

In the 1964 contract, the contractor furnished chemical, diesel fuel carrying agent, flagmen and mixing crew. The area was only 300 acres which contributed to excessive moving costs per unit. Bid price was $4.45 per acre. Much lower costs can be predicted if projects are larger in area, chemical and carrying agents are furnished by BLM, and flagmen and mixing crews are furnished by the contractor.

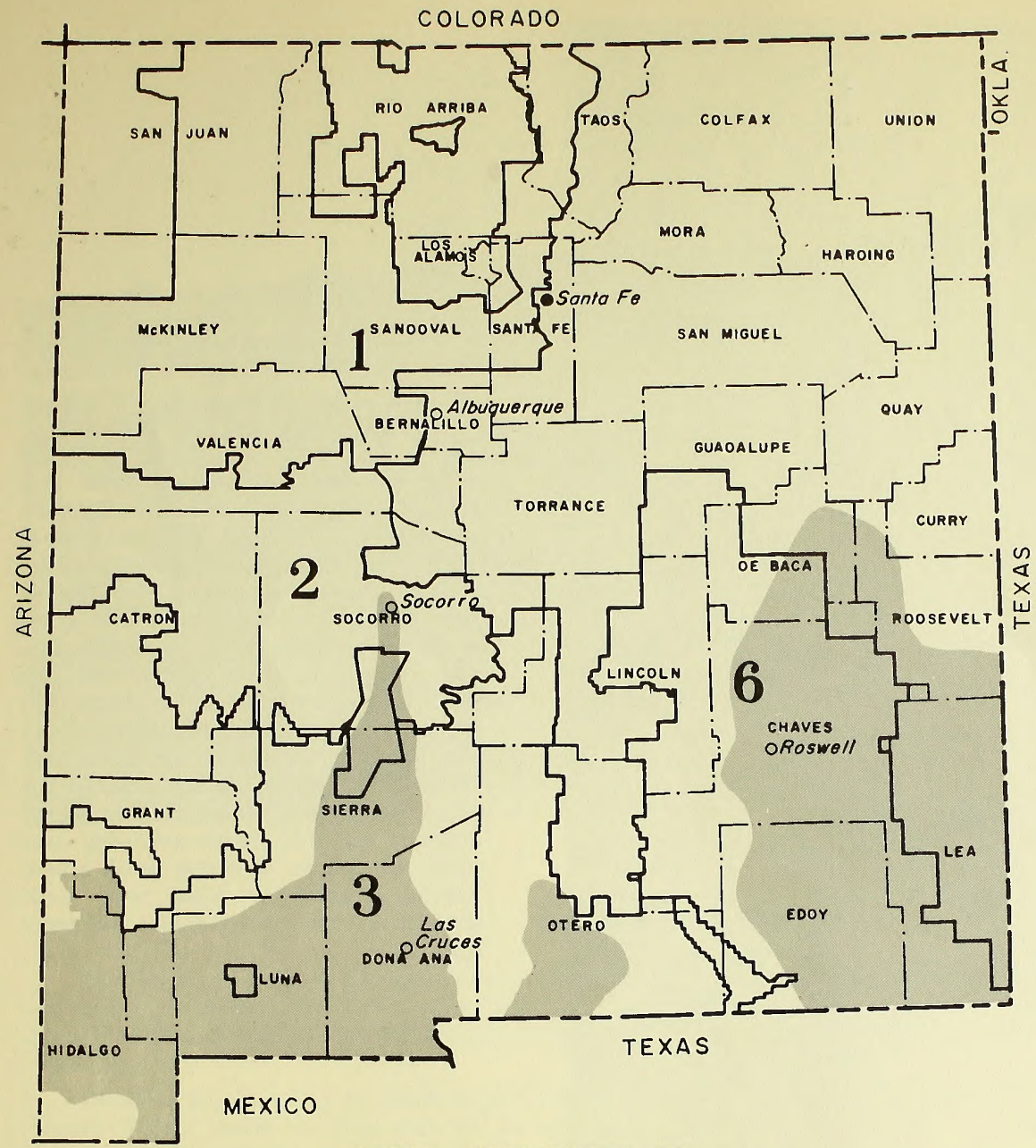
Spraying requires an optimum growth period in the sage and it has been our experience that tremendous variation in dormancy periods of sagebrush may occur due to moisture availability. This factor makes it difficult to schedule contracts so that order to proceed may be issued at the time at which spring growth is most active.

Both 2,4-D and 2,4,5-T are effective on sage brush with water oil-water emulsions and diesel oil as carriers.

A typical creosote—tarbush stand chopped and unchopped

SPRAYING CREOSOTE BRUSH

Several spray formulations have been used on creosote brush and tarbush, including 2,4-D and 2,4,5-TP. All past spraying trials have been done with ground equipment on chopped brush, (the chopping was done with a Servis rotary-type brush chopper), and unchopped brush. No satisfactory results have been accomplished thus far on creosote brush or tarbush either. The Bureau of Land Management in the southern part of the State and the Agricultural Research Service are working together under cooperative agreement whereby several different types of sprays are being used which are felt to be active brush killers. Several experimental plots were aerial sprayed in 1964 and results are still pending.



AREAS APPLICABLE TO MESQUITE CONTROL

MESQUITE CONTROL

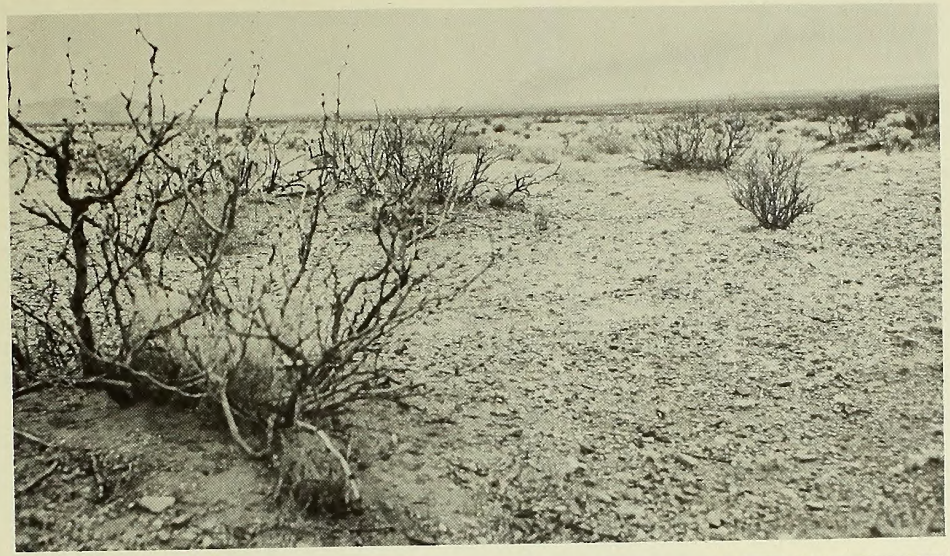
(Prosopis Juliflora)

A strong attempt to retard the invasion of mesquite, (*Prosopis juliflora*) into valuable rangelands is being made. It is estimated that within the last 50 years the area occupied by mesquite plants has practically doubled. A complete evaluation of the present treatments has not been made due to the 3-5 year period required to completely kill the plant. Of what has been evaluated, the results and benefits received have been very good.

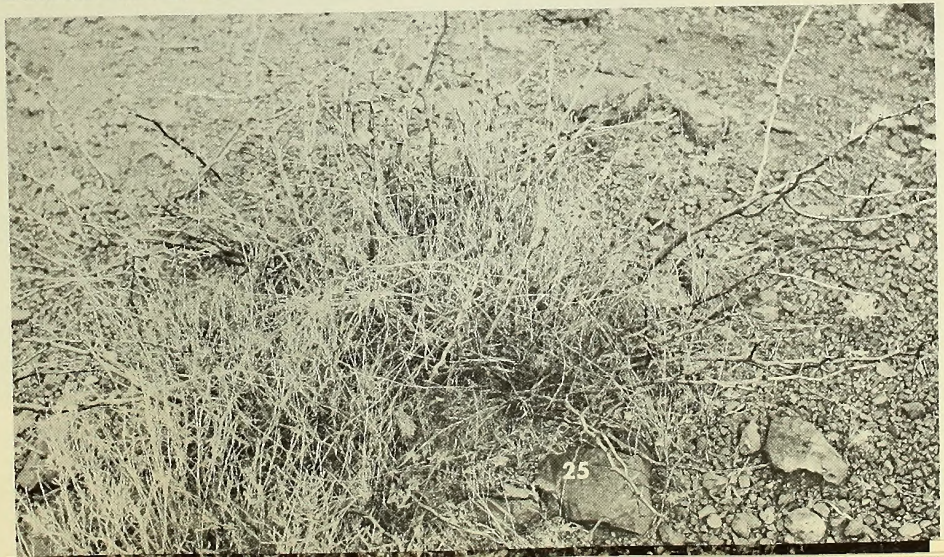
Purpose: One of the main purposes for controlling mesquite is to eliminate its competition with perennial grasses which are essential for livestock production. Mesquite leaves and beans do provide some forage but do not begin to replace the forage it crowds out. When mesquite completely suppresses perennial grass, forage production is reduced to almost zero and wind erosion is greatly augmented.

Description: The present control of mesquite consists of the use of "Dybar" Fenuron Pellets and aerial application of spray material.

Applying "Dybar" to mesquite



A treated stand



A sign of good results

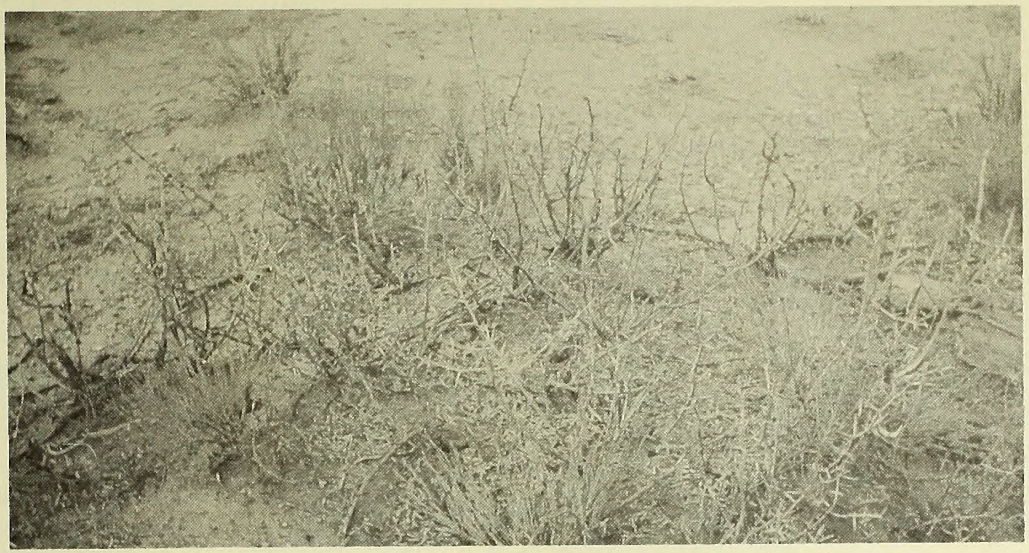
APPLYING DYBAR PELLETS TO MESQUITE

The pellets are scattered by hand uniformly throughout the mesquite clump at a rate of one tablespoon per plant per three foot canopy. Applications which are made by hand, may be made at any time except when the ground is frozen, providing adequate moisture is supplied by rainfall or snow. The most desirable time is immediately preceding an expected rain. The pellets are dissolved by the moisture and absorbed by the root system. Mesquite plants may continue to leaf out for several seasons following treatment before complete kill results. The suppressed mesquite plant provides excellent protection for the establishment of desirable forage.

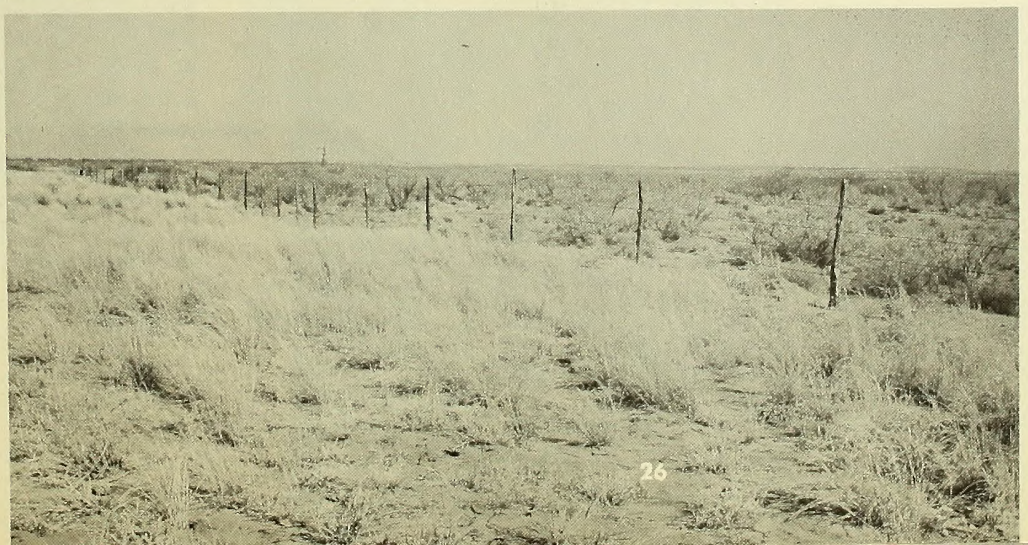
A desirable site for mesquite control with dybar must contain a light stand of msequite plants per acre. 15 to 35 plants per acre is a recommended site. There must also be a presence of desirable forage plants or remnants of these plants. This type of treatment is not economical on heavy stands of mesquite.

The cost to the Bureau of Land Management is approximately $1.00 per acre for the chemical with a $.25 per acre cost for the rancher's labor in distributing.

Aerial spraying mesquite



A sprayed plant



Several years later

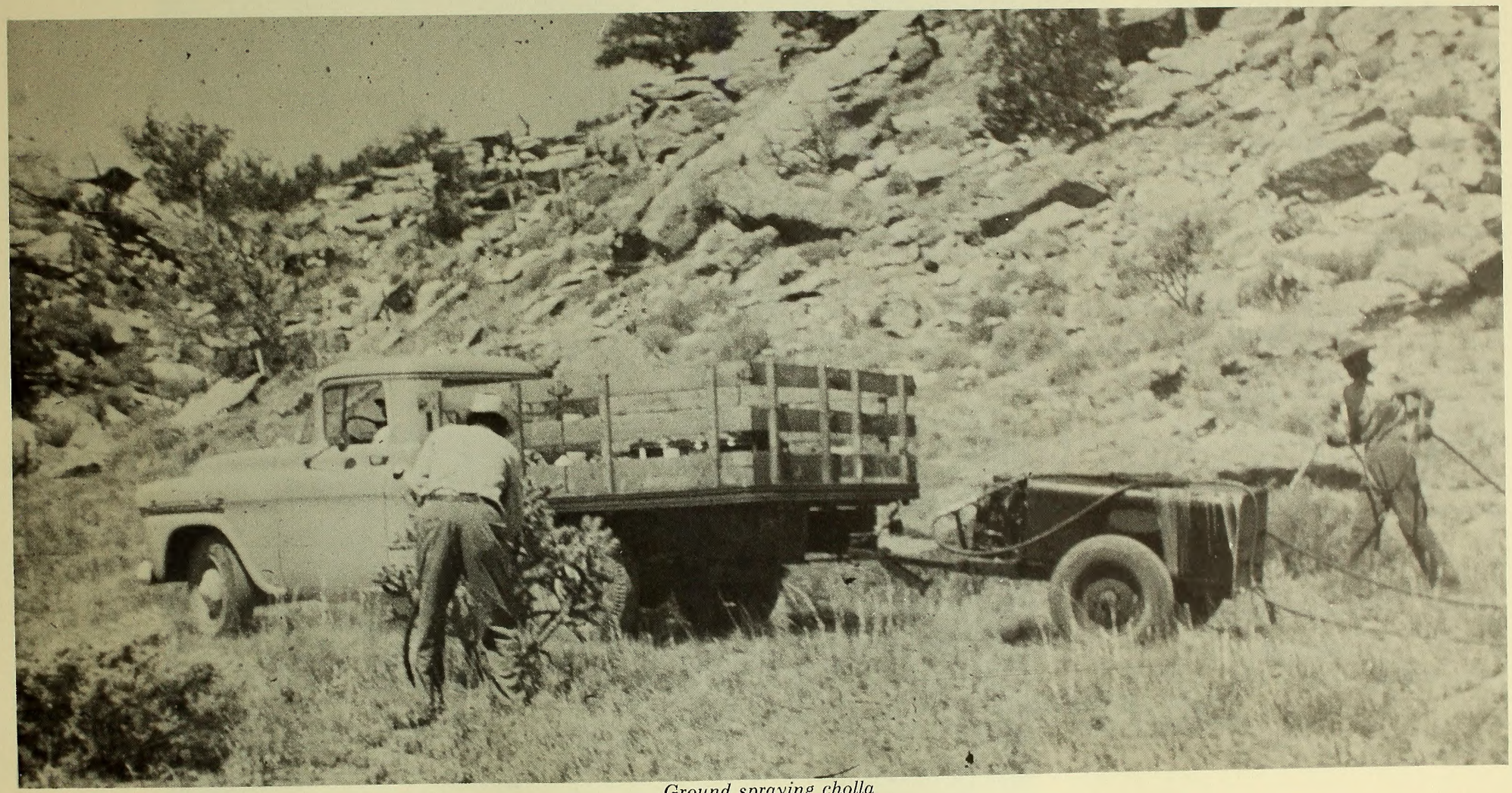
AERIAL APPLICATION OF SPRAY MATERIAL ON MESQUITE

Equipment needed for this type of application are aircraft of 450 horsepower or less and two mixing tanks of at least 500 gallon capacity with mechanical agitators. The spray material used is 2,4,5-T herbicide in the form of "Butoxy Ethanol Ester" or "Propylene Glycol Butyl Ether Ester" mixed with an emulsion of diesel oil and water. The spray must be distributed evenly over the area at a rate of five gallons of spray formula per acre. The height of flying should not be more than 10 feet above the vegetation. Flying is done between 4:00 a.m. and 11:00 a.m. and should not be applied when wind velocities exceed five miles per hour or temperature exceeds 90°. The cost is approximately $2.25 per acre per treatment and two treatments are required at five year intervals. Results have been very encouraging.

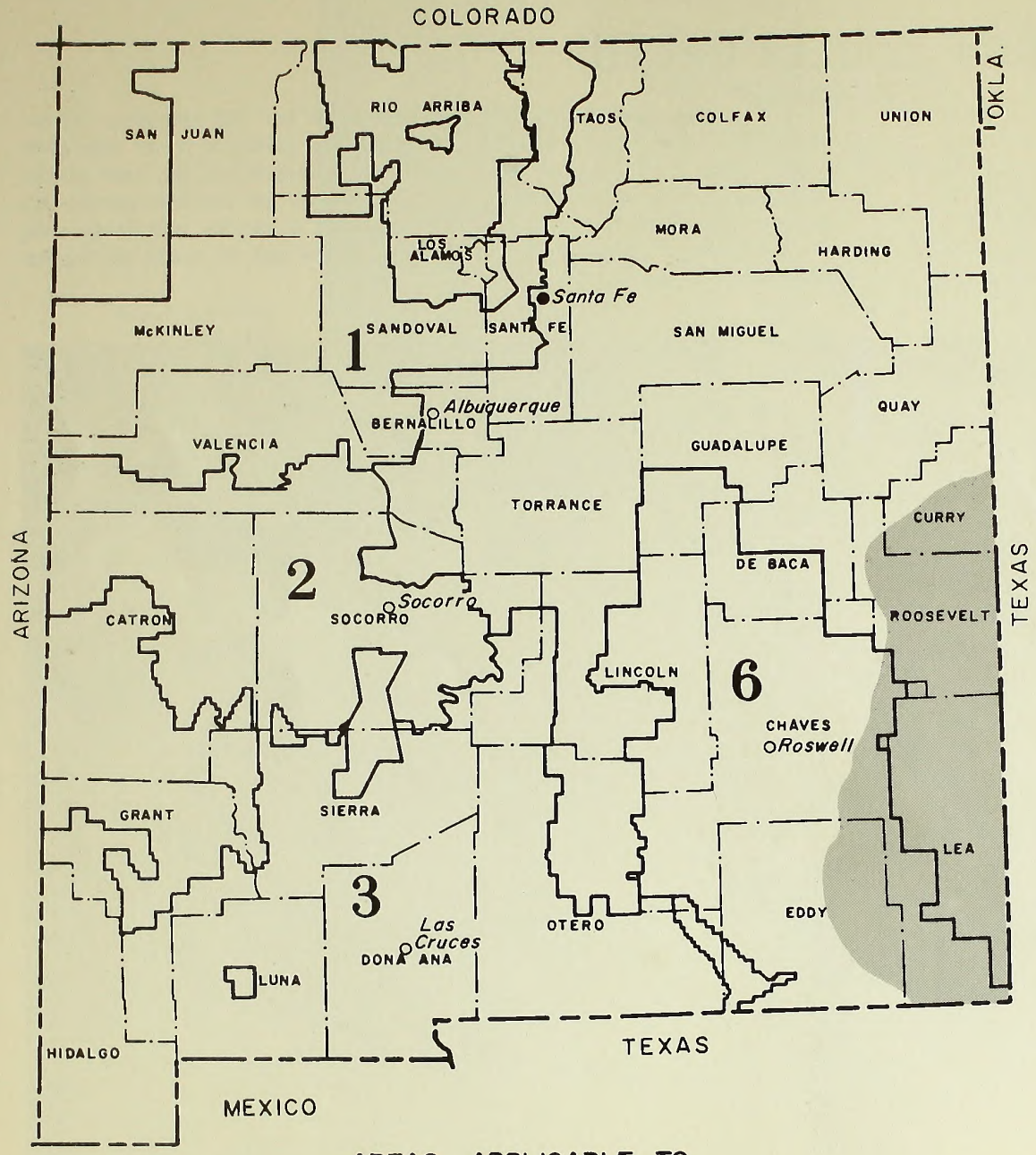
Requirement: A deferment of seven months is required wherever spraying applications are completed. Also fencing may be necessary for deferment.

SPRAYING OF CHOLLA CACTUS

There are no herbicides presently available that will control cholla cacti economically on extensive areas. Currently, the only place for chemical control of cholla lies in spot treatments of small localized infestations with ground equipment. In this respect a number of herbicides can be used to advantage. Low volatile ester of silvex and 2,4,5-T will give adequate control. TCA and DNBP are also effective for spot treatments. High concentrations must be used. Eight to ten pounds acid equivalent per 100 gallons are recommended for silvex and 2,4,5-T, while twelve pounds active ingredient per 100 gallons is recommended for DNBP. ½ to ¾ pounds of TCA per gallon of water also gives adequate control. With the exception of TCA, diesel oil is the best carrier for the other herbicides mentioned. July and August are the best months for treatment with silvex and 2,4,5-T. DNBP and TCA can be effectively used over a wider range of season, but treatments should not be made during extremely dry seasons.



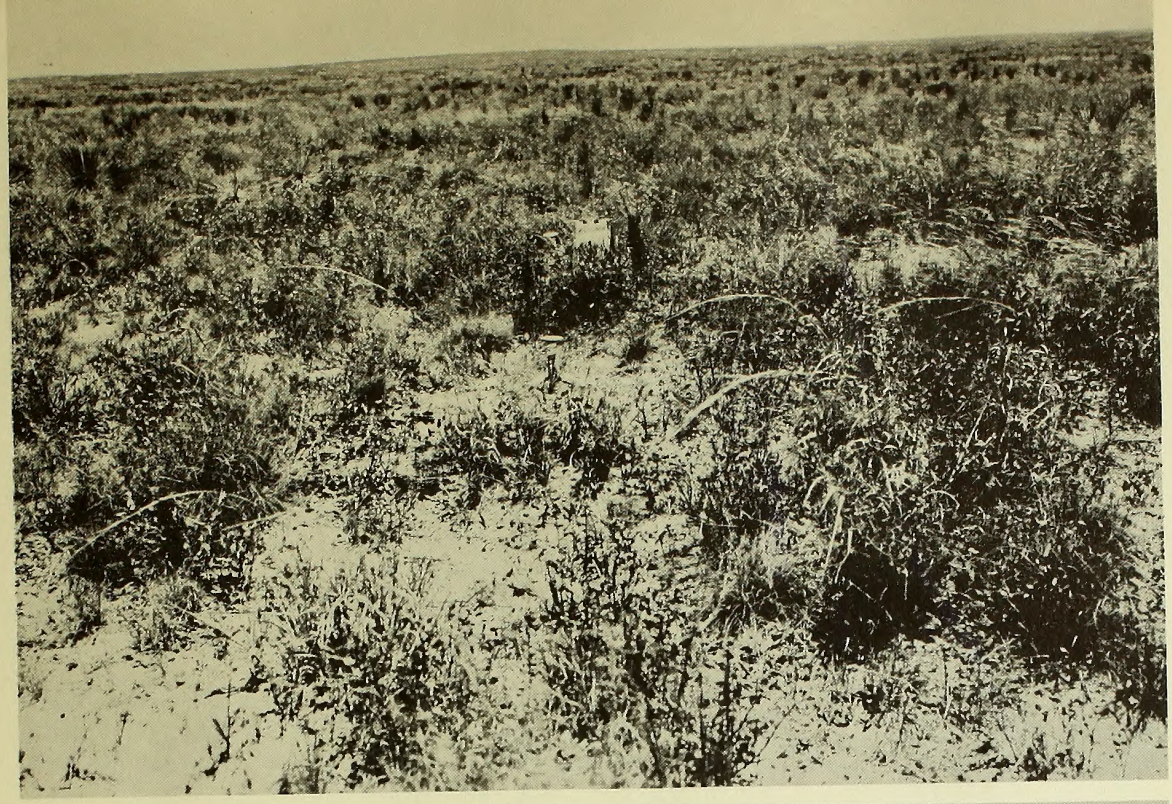
Ground spraying cholla



AREAS APPLICABLE TO SHINNERY OAK CONTROL

SHINNERY OAK CONTROL

(Quercus Havardi)



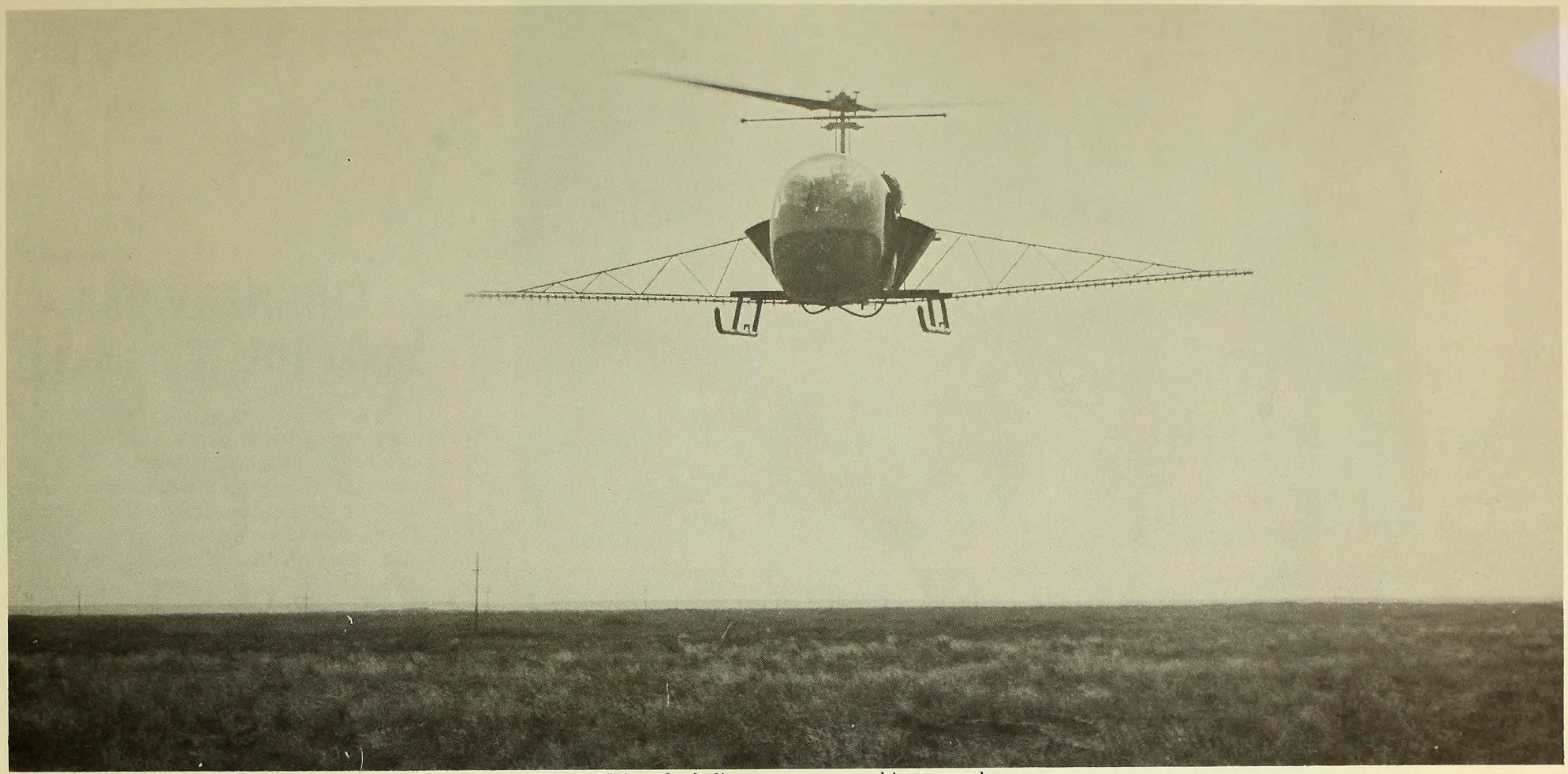
Shinnery oak site before spraying

Shinnery oak site after spraying

SHINNERY OAK CONTROL (Continued)

Shinnery Oak (*Quercus havardi*) is a dense low growing shrub which is highly competitive with range grasses. This low growing oak is also poisonous if eaten without other forage or under special conditions. Chemical control by spraying has shown that grass production can be greatly increased even though shinnery oak cannot be easily killed.

Purpose: The purpose for controlling shinnery oak is fairly well outlined above. Shinnery oak competes directly with more desirable range plants for moisture, sunshine, nutrients and space. On some New Mexico ranges it is somewhat important as emergency feed, but as was mentioned above, can be poisonous under certain conditions.



Using the helicopter to spray shinnery oak

AERIAL SPRAYING OF SHINNERY OAK

Description: Where a remnant of good native grasses are present in a shinnery oak stand, a minimum of two sprayings of ½ lb. silvex in one gallon of diesel per acre will give good results for the control of shinnery oak.

Where yucca (*Yucca species*) and sand sagebrush *(Artemisia filifolia)* are interspersed with shinnery oak, one treatment of ½ lb. silvex in one gallon of diesel and two gallons water per acre followed the next year by a treatment of ½ lb. silvex in one gallon diesel per acre will give satisfactory results on the oak, yucca and sagebrush. The cost of these treatments ranges from $0.86 to $2.93 per acre depending on the spray formula used. This type of treatment is usually let under contract and the equipment used is essentially the same as that used in aerial spraying mesquite. (See Brush Control - Chemical - Mesquite - Aerial Spraying.)

Requirement: The area sprayed is deferred for at least one growing season. The stocking rate is set on an annual forage inventory basis and any increase in stocking rates are made with livestock which can be disposed of on short notice.

FENCING

Includes all fencing used as an integral part of a conservation treatment plan for the protection of conservation work and for the rehabilitation of eroded or deteriorated lands.

Fencing is a recognized range management practice which is of increasing importance to the livestock industry.

Purpose: Fencing serves many purposes. It aids in the control and distribution of livestock. It provides for efficient utilization of the range area and better management of livestock. The BLM uses fencing also to protect treated areas such as contour ripping, reseeding, brush control and other practices, of which the primary purpose is to establish or regain forage stands that require a strict deferment, especially through the growing seasons, allowing the desirable perennial grasses to mature and reproduce.

Description: Specifications are standard as to specific needs and must be strictly applied in the construction. Where the fence crosses a well traveled road, cattleguards are needed. (See Program Facilities - Cattleguards.)

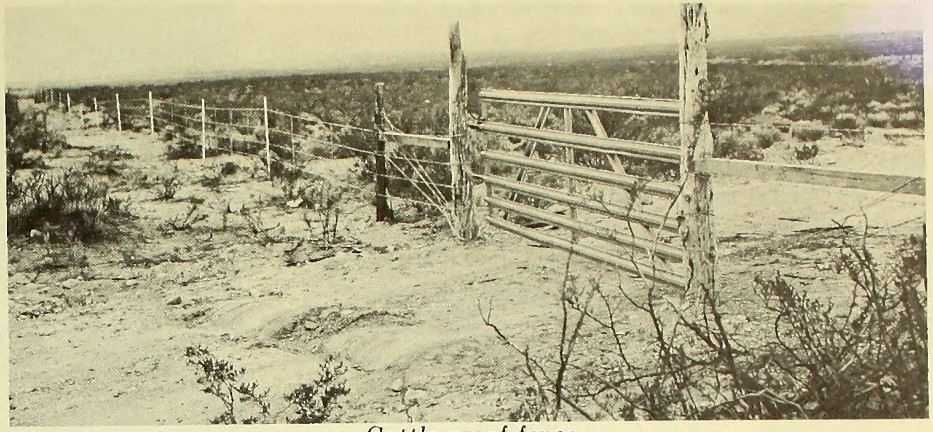
Fencing Regular and Sheep Proof

All fences must be built to meet requirements as agreed to with the State Game and Fish Department. Whether construction is made by cooperative agreement or by contract, the fence will be constructed with the materials furnished, and in accordance with the specifications and detailed drawings developed with interested agencies and furnished to the districts by the Division of Engineering.

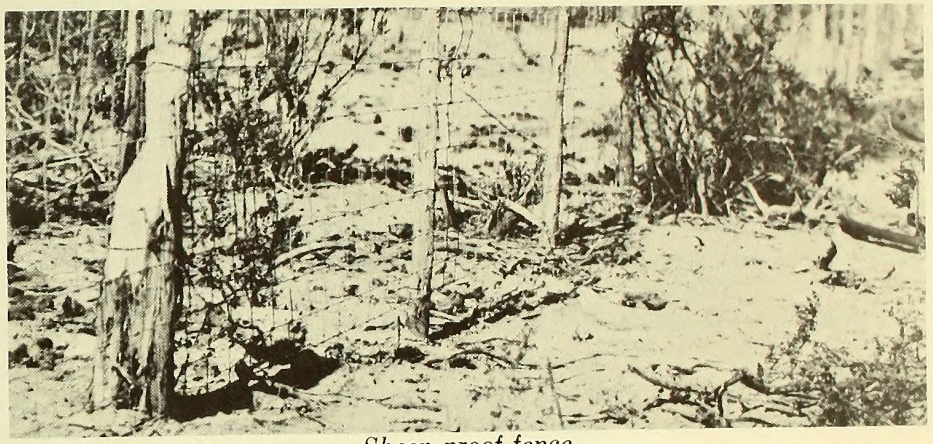
The cost of fencing varies considerably with the topography of the country. A standard four barbed wire fence with posts spaced from 16′ to 21′ costs approximately $350 to $450 per mile. The labor varies more with the terrain, running from $250 to $450 per mile. A net wire or sheep proof fence can run from $600 to $700 per mile for material and from $800 to $1,000 per mile for labor.

Fencing — Study Plots

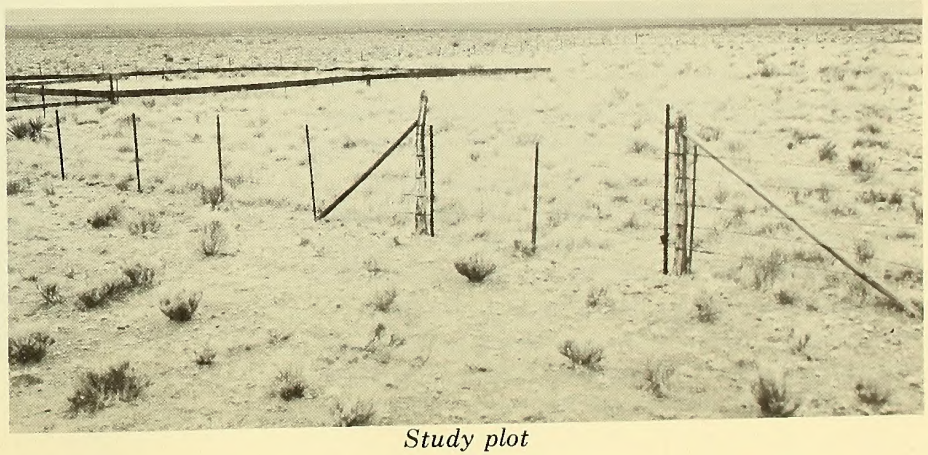
The BLM is involved in ecological, forage utilization, livestock and game studies. In most cases some type of fence is constructed to allow for a more accurate and detailed study. These plots are usually constructed on federal land in desirable areas. The study plots vary in construction including cattle proof, game proof, rabbit and rodent proof, and open plots.



Cattle proof fence



Sheep proof fence



Study plot

SEEDING

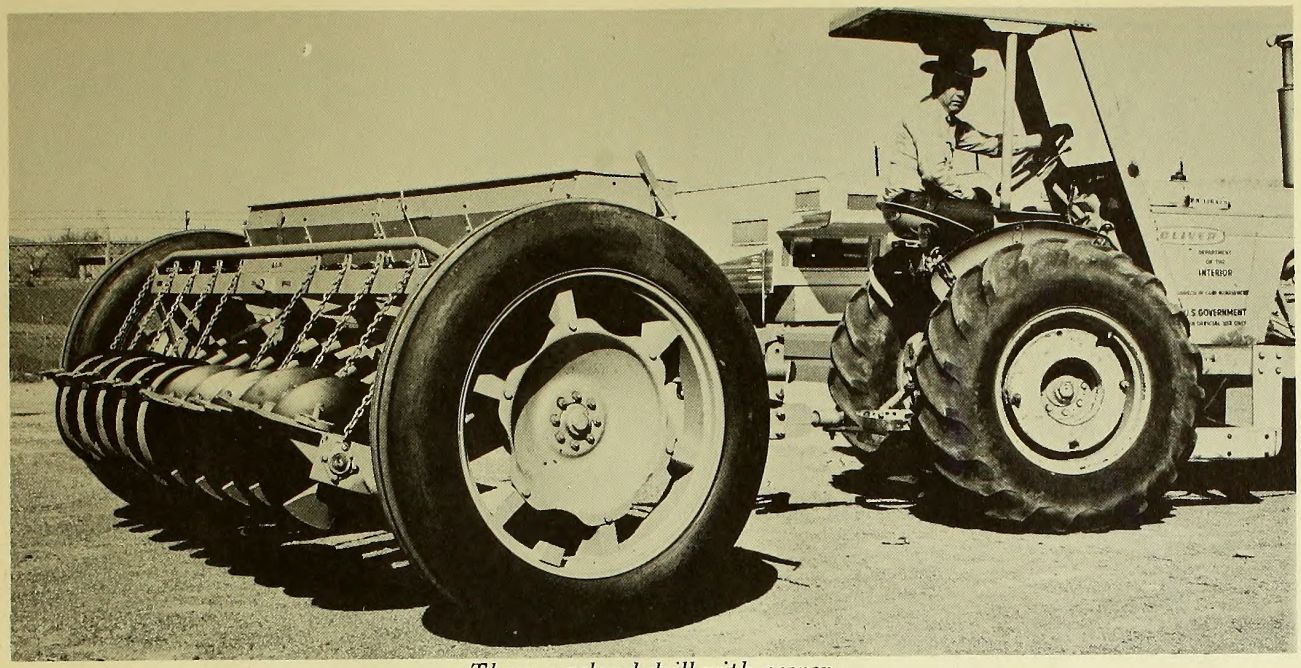
Includes the soil preparation, competition removal and subsequent planting of adapted grasses, forbs or browse which provide greater forage production, more ground cover, more resistance to erosion and improve soil structure and infiltration.

Many areas of rangeland in New Mexico are much less productive than they should be. Much of the rangeland has been depleted by drought and overgrazing. Some areas can be improved through light or deferred grazing. On badly depleted rangeland, however, it is advisable to reseed adapted range grasses.

Purpose: The purpose for reseeding needs little, if any, explanation. Areas which show characteristics suitable for supporting vegetation, but are supporting little to none, are numerous throughout the State. Areas needing seeding will be aided by other land practices which will in some way prepare a seedbed or by specific seed bed preparation procedure to aid in controlling excessive runoff. Some of these practices could be brush cutting, plowing, contour ripping, chaining, etc.

Description: Some Bureau of Land Management districts within the state have their own rangeland drill which costs from $1,700 to $2,000. The drill is used before, after or during certain land treatment practices. Any medium-sized farm-type tractor is capable of pulling the drill.

The rangeland drill was first manufactured by altering and reinforcing the standard grain drill. Later they were manufactured on a commercial



The rangeland drill with power

A reseeded area

SEEDING (Continued)

basis. The drill is about 13½ feet wide and drills a swath approximately 10 feet wide. Seeder arms are set one foot apart and are hinged where they are attached to the seed hoppers so that they will ride over rocks and other debris. The drill is mounted on rubber tires approximately 51 inches in diameter.

The Rangeland Drill is well adapted to seeding on rough terrain. Its large rubber tires and hinged seeder arms allow it to be pulled over anything that can be driven over with a tractor.

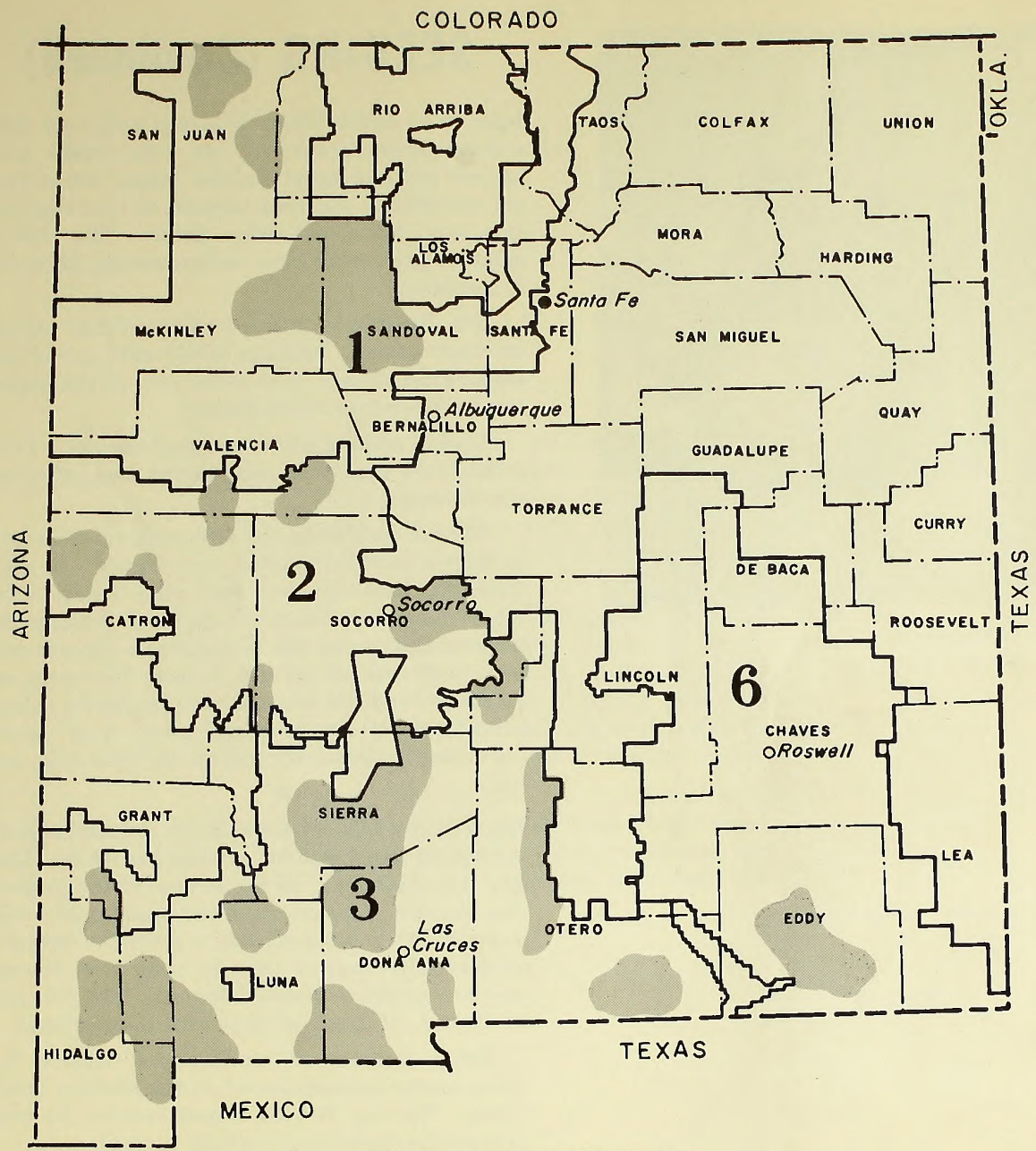
Cost of seeding alone runs approximately $1.50 to $2.50 per acre. This includes the seed, labor and tractor costs.

Results from using the drill, with no other land treatment practice applied, vary widely. In some cases, we have received very good results while others have been complete failures. Possibly the cause of this is that the drill disturbs the soil very little and does not greatly increase the water absorption. We have received good results by pulling a drill behind the rangeland plow. Poor results have been attained by pulling the drill over raw land.

Requirement: All areas which are reseeded require a complete deferment for at least two years. This may vary depending on the success of the project. The reseeding projects could not possibly be a success with cattle being allowed to graze the reseeded areas the first year or two. In some cases fencing may be required to permit deferment. (See Fencing, for Bureau of Land Management cooperation.)

Other methods of seeding used include the use of seeder boxes mounted on the Marden Brush Cutter, The Jay Hawker Ripper and on the tractors used in chaining and cabling operations.

Crested wheatgrass (*Agropyron cristatum)* is the primary grass seed used in the northern part of the state while mixed gramas (*Bouteloua species)* are used in the southern part of the state.



AREAS APPLICABLE TO EROSION CONTROL

Other Soil Stabilization Practices

Includes contouring, deep plowing, checks, fertilization, tree and shrub planting, pest control, weed control or other practices which aid in reducing erosion, rebuilding soil, improving soil fertility and structure and reducing loss of water.

Examining a rip

First year results

DEEP TILLAGE

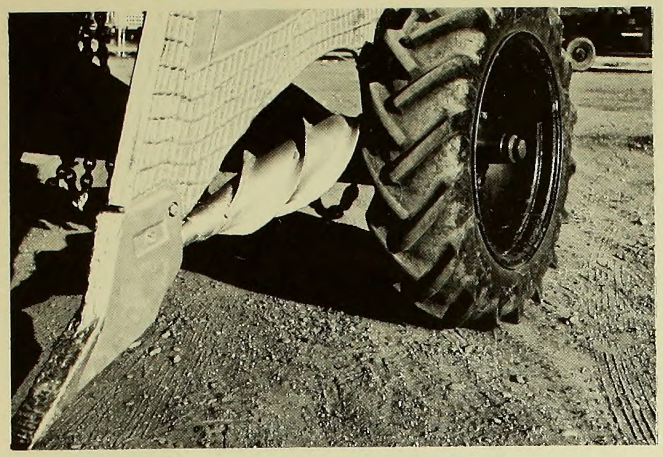
Deep tillage has a variety of descriptive names including range contour ripping, deep ripping and chiseling.

Deep tillage has definitely proven itself as an extremely profitable practice in applicable areas. Almost every area ripped has had a substantial increase in ground cover.

Purpose: The main purpose of deep tillage is to control moisture runoff on light to moderate slopes containing virtually impermeable soils. Considerable moisture is lost to these areas due to the torrential type rainstorms of the greater part of New Mexico. In turn, the purpose in controlling the runoff is to create and establish a desirable stand of good quality vegetation, thus improving the overall watershed. Ripping or tilling produces several desirable effects. It shatters surface crusts and subsurface hardpans. This not only controls runoff, but allows for greater storage of water in the soil.

Desirable sites have surface water movement and have medium to heavy textured, deep soils, moderate slopes without numerous deep, sheer-sided gullies or arroyos. Soils must not be greater than 40% silt or classed mechanically lighter than a heavy sandy loam or life of the rips is very short under normal rainfall. Silty soils are also susceptible to "piping," thus accelerating erosion.

DEEP TILLAGE (Continued)



The jayhawk ripper

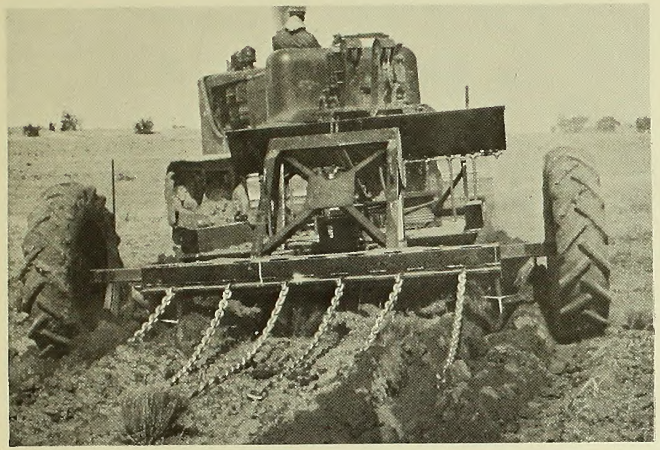
Description: A model 2, wheel-type "Jayhawk Soil Saver Ripper," with screw type spinners is most commonly used to accomplish the ripping operation. This ripper is usually pulled with a D-8 or D-9 Caterpillar Tractor or equivalent. The depth of ripping usually varies from 20"-28" with one pair of rips being 6' to 7' apart, which is the spacing of the two teeth on the ripper, then a distance of 14' is left and another pair of rips are made. All ripping is done (strictly) on the contour. In some instances furrow breakers mounted on the back of the ripper are used, which makes an 18" wide furrow, 6" deep at the top of the rip. This type of treatment is done under contract and usually varies from $4 to $5 per acre.

Seeding can be done in conjunction with ripping but has not always proved successful. In some cases, fairly good stands of grass are obtained. In some instances, very little of the seeded grass comes up. Stands of native grass of the deep rooted variety are almost always improved by ripping. The aereation (roughening) of the soil and increased infiltration stimulates (root) growth.

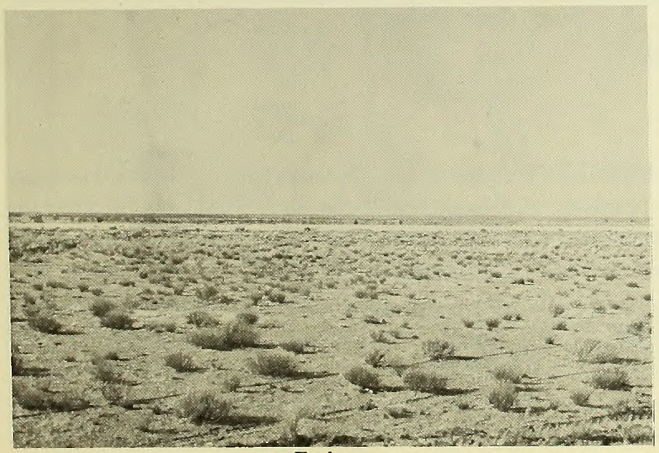
Early results received have been encouraging in the control of surface water movement and establishment of plant cover.

There is a limitation in areas adapted to this practice but projects will continue to be scheduled as long as adapted areas are available.

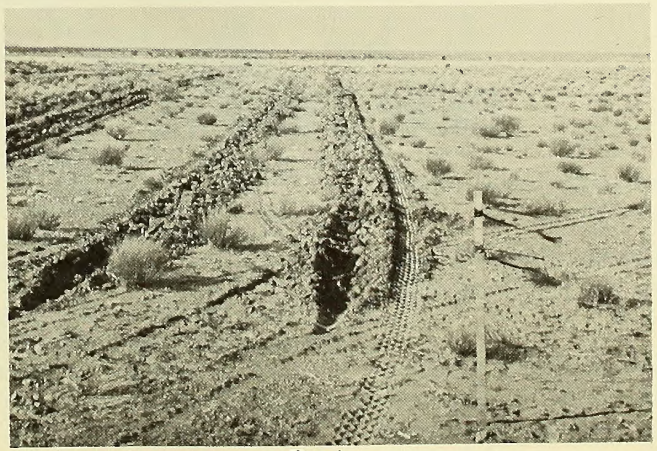
Requirement: The Bureau of Land Management in some areas required the area ripped to be deferred during the growing season for at least two consecutive years. If any seeding is done in connection with the ripping operation, a yearlong deferment is required for at least two consecutive years.



The ripper with seeder attachment



Before



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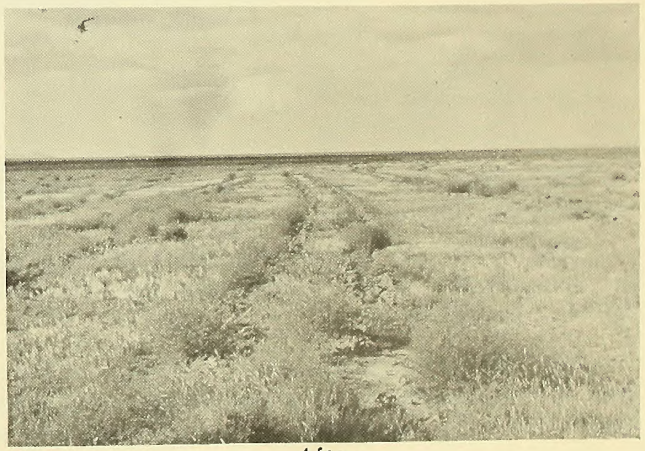

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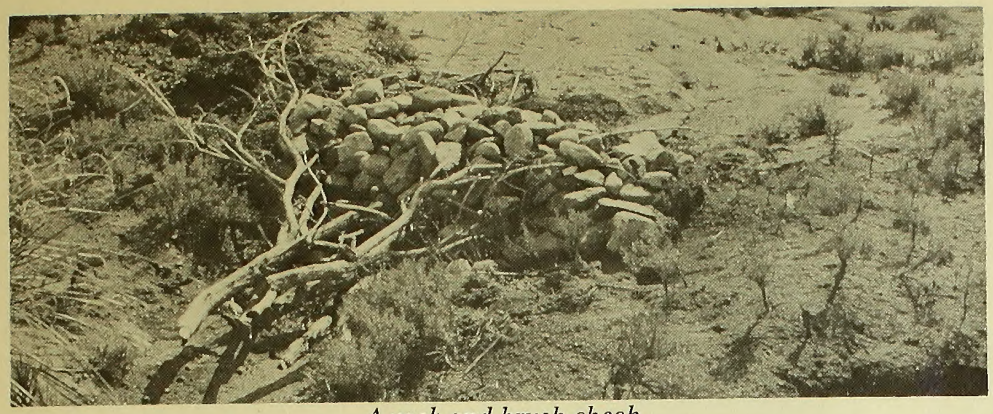
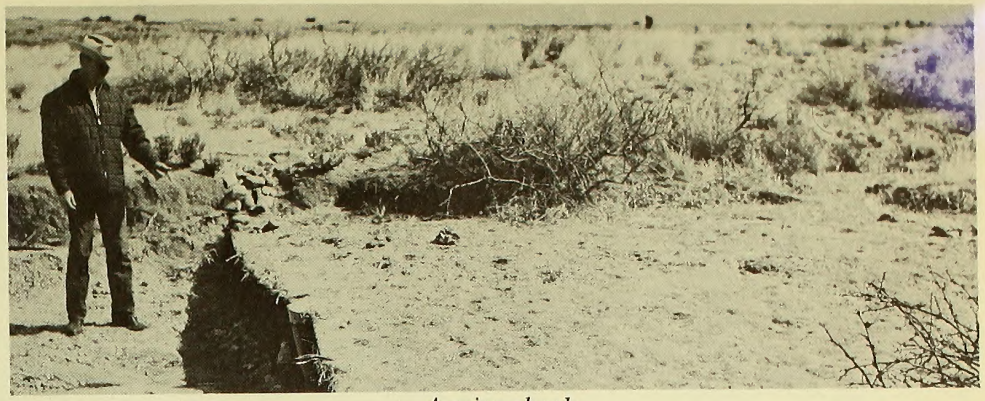


A rock and brush check



A wire check

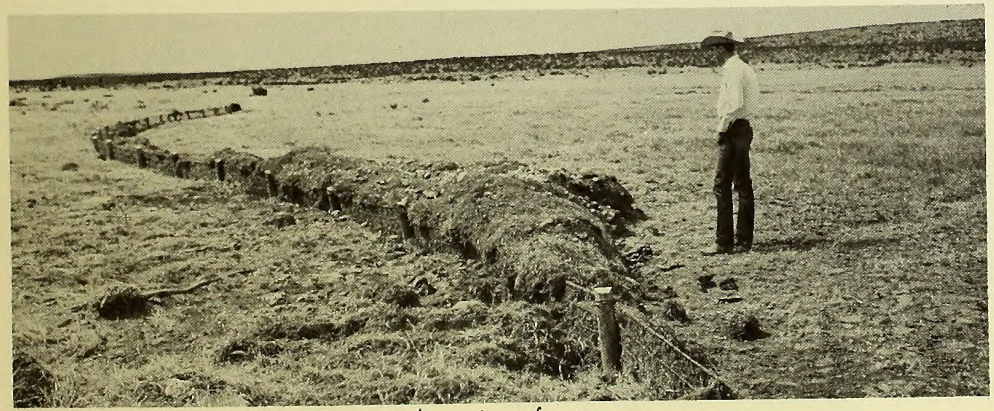
CHECKS

This heading will include contour fences, wire, rock, and brush checks. This practice appears to be one of the more beneficial practices in controlling soil erosion in its beginning stages.

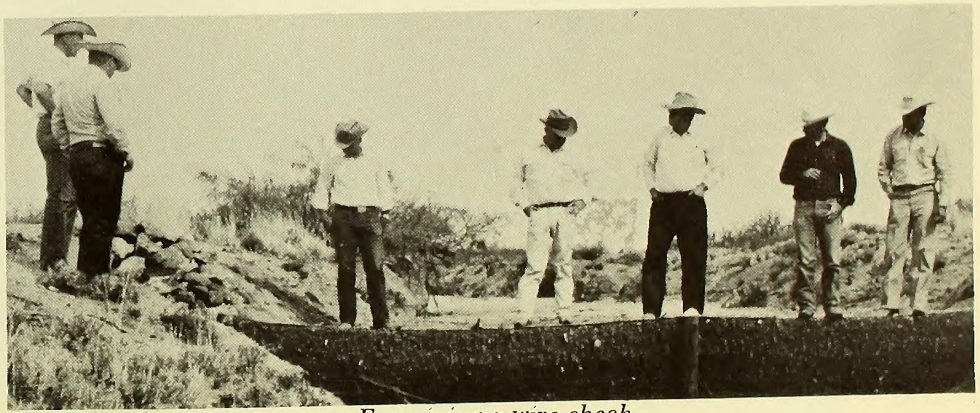
Purpose: The purpose of this type of treatment is to control soil erosion and excessive runoff.

On lands which are somewhat steep and rolling, well-defined trench channels are readily formed where the plant cover is destroyed. A large portion of the water from heavy rains finds its way into the channels and the water, washing rapidly down, carries away much of the loose soil over which it passes. By controlling this runoff and erosion, a soil rebuilding process is begun and vegatative stands are regained.

Description: This type of treatment consists of the actual construction of wire fences and wire checks and the placing of rock and brush in gullies and channels. Where wire is used, treated or juniper posts are buried at least 2 feet below the surface. One-fourth inch steel cable may be stretched across the length of the fence or check and securely fastened to deadmen which are also buried. "V" mesh wire is fastened to the posts and cables and buried in a trench 15″ deep. The trench is then backfilled to the original ground level. This practice can vary considerably according to the type of structure required. In some cases contour fences are used which are constructed in the same manner but are generally much longer and are designed to hold water and silt out of existing gullies. These, as their name implies, are constructed on the contour. Rocks, brush and wire may be used in various combinations. The rock and brush checks are used on smaller channels before they enter the larger gullies. The wire fence work is done under contract and usually runs from $0.90 to $1.15 per linear foot of fence. This cost can also vary considerably where rock checks and brush checks are used.



A contour fence



Examining a wire check

A kangaroo rat den

PEST CONTROL

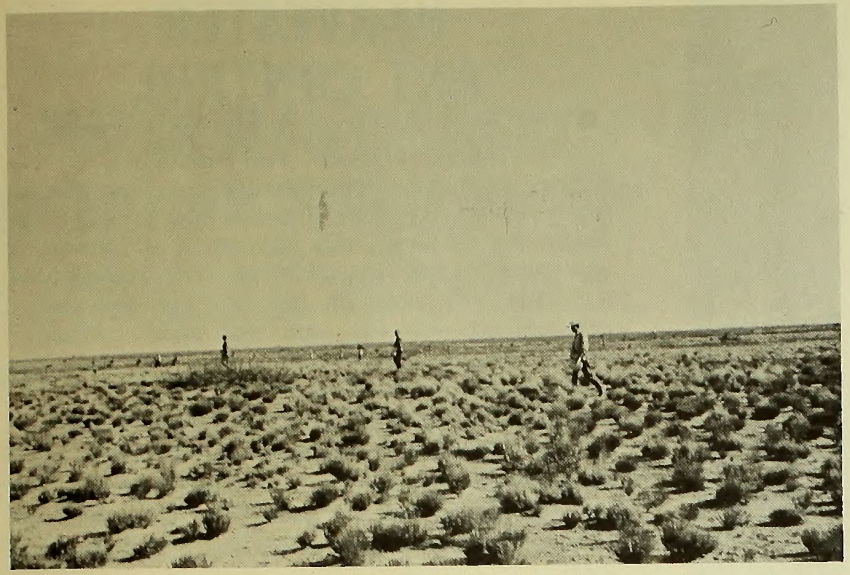
Pest control in New Mexico within the Bureau of Land Management is primarily limited to rat or rodent control and harvester ant control.

Rodent Control

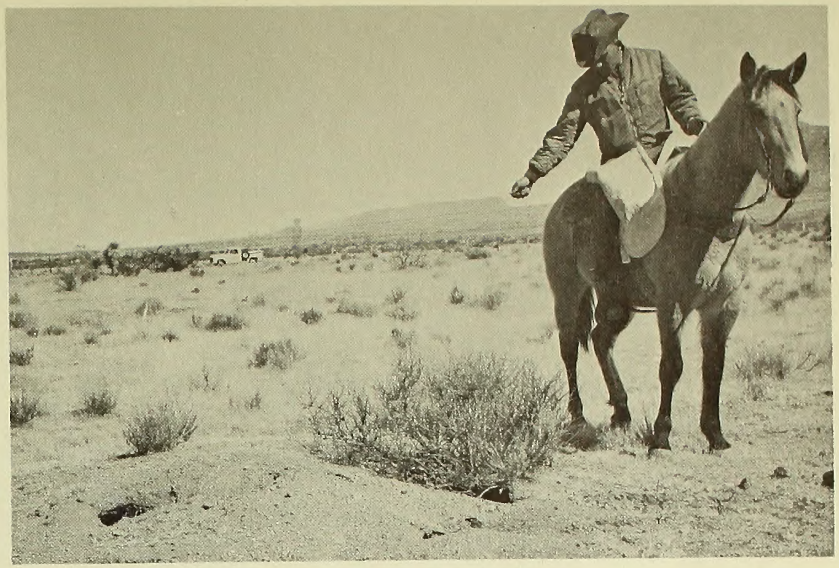
Rodents retard the natural revegetation of severely depleted ranges, contribute largely to the failure of many reseeding projects and have caused "washouts" in earthern dikes and dams. Thus rodent control is an important range conservation measure.

Purpose: Rodents cause considerably more damage than most persons realize. The rodent causing the most destruction in southwestern New Mexico is the Kangaroo Rat. These rodents cause extensive damage by burrowing in existing erosion control structures and earth stock tanks. These rodents also do extensive damage to vegetation by clipping plants and gathering seed. This is to say nothing of the considerable space occupied by their dens.

Description: Poisoned grain is used for rodent control. The grain used is primarily oats with strycnine added. The preparation of this grain is supervised by the United States Fish and Wildlife Service. It is estimated that an average number of rat dens in an area will require approximately 100 pounds of poison grain to each 640 acres.



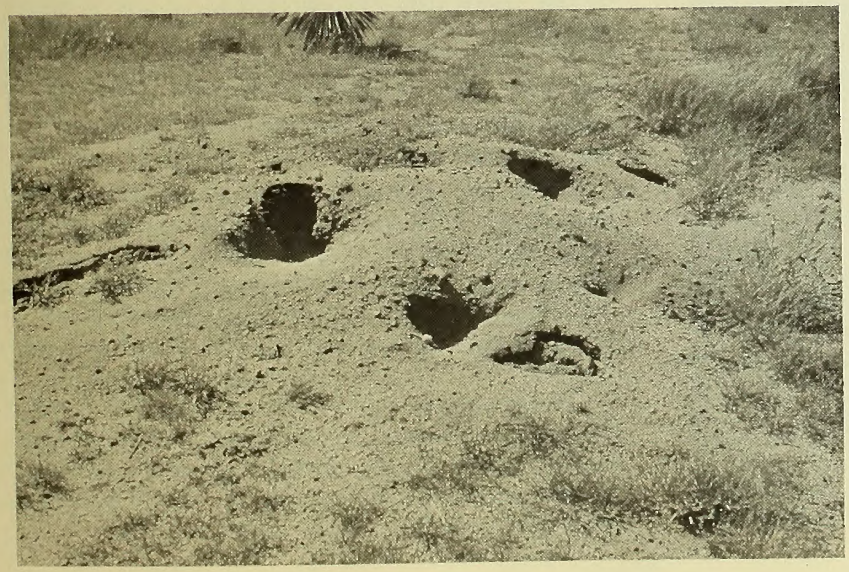
Distributing poison grain on foot



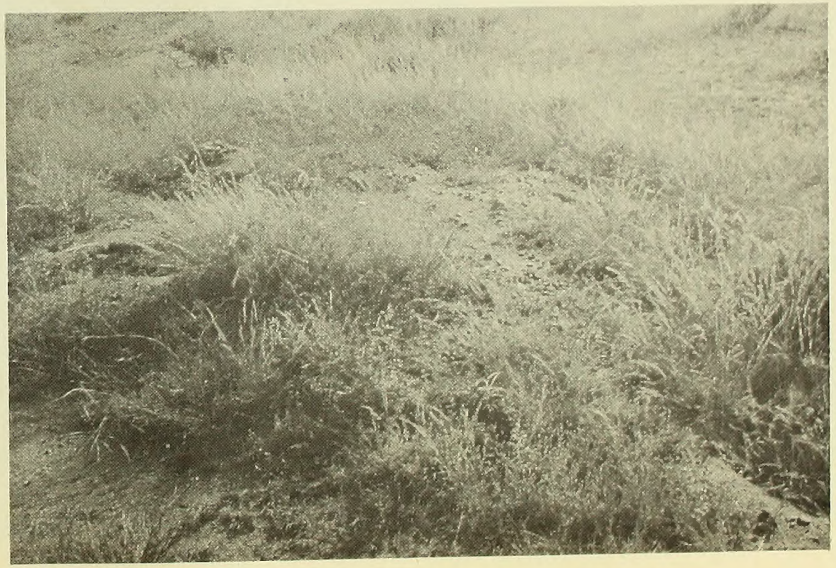
Distributing poison grain on horseback

PEST CONTROL (Continued)

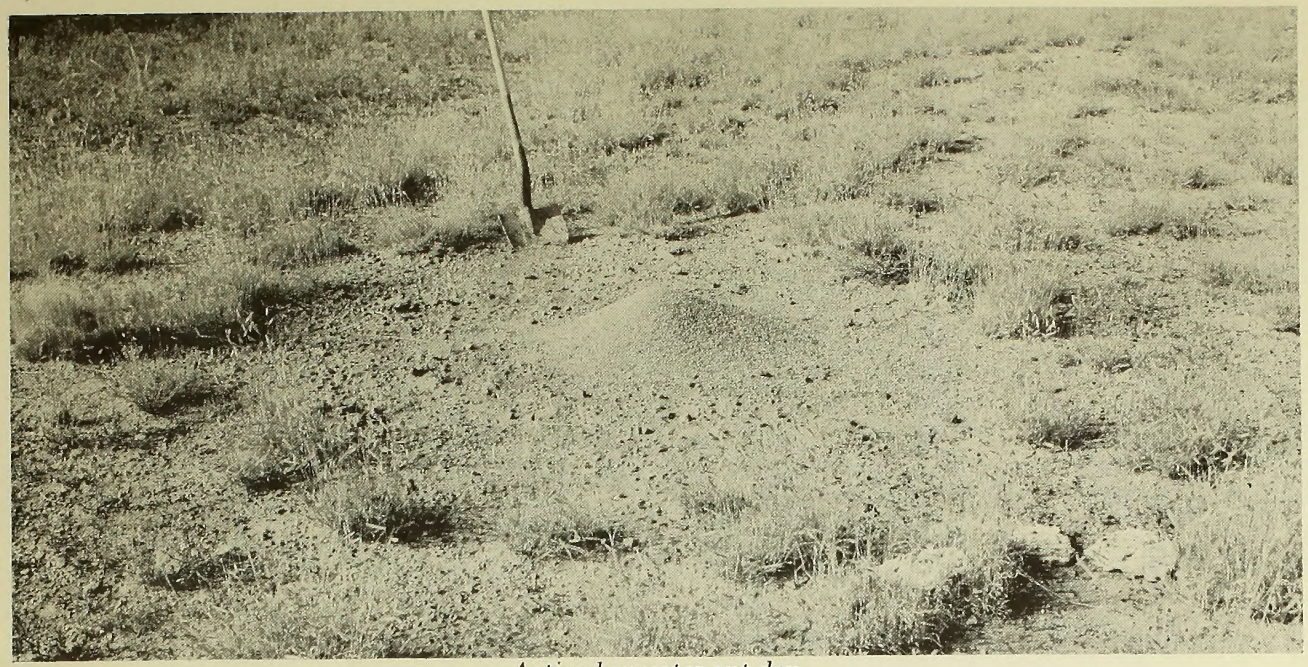
The grain costs from $13 to $16 per hundred pounds. The cost of distribution is from $0.05 to $0.10 per acre. This would make a unit cost of $.07 to $.12 per acre. The grain is scattered lightly around the openings of the active dens or along active trails either on foot or horseback.



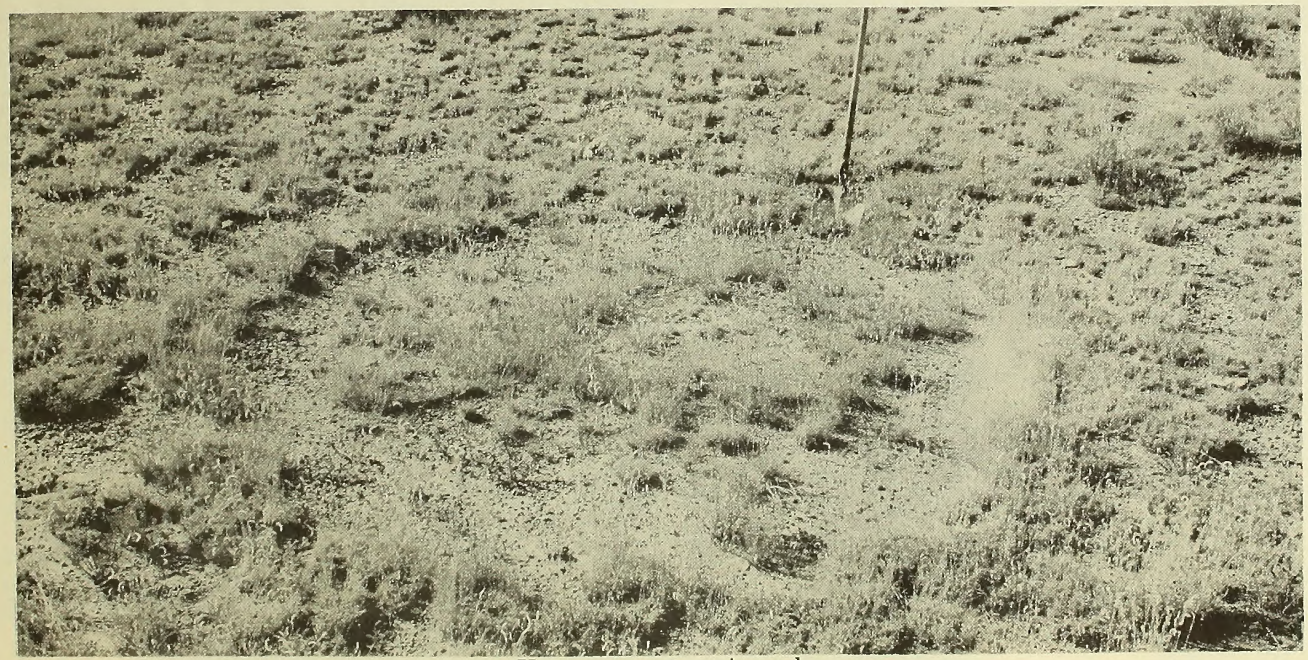
A treated rat den collapsing



Vegetation moves back on inactive dens



Active harvester ant den



Harvester ants poisoned

HARVESTER ANT CONTROL

A cooperative study was conducted by the Bureau of Land Management and New Mexico State University on harvester ant control. The reason for the study was because of an increase in the population of harvester ants and the individual ant hills. Wherever an ant hill is established, a surrounding denuded area will result. When a colony of ants is established, these bare areas can amount to considerable acreage.

In May of 1961, three 100-acre plots were sprayed with three types of poisons. The Bureau of Land Management agreed to analyze the revegetation of the ant hills on one of these. The 1080 poison was selected because it offered the best kill of the three plots.

The study is set up to keep a permanent record of the vegetation along a belt transect placed across the denuded area within two plots, the 1080 and a check plot.

The conclusion of the study in 1963 showed an increase in density of blue grama (*Bouteloua gracilis)* on both treated plots. The increase in density on the check plot was believed to be due to above average rainfall the previous year. However, there is an increase in density of Blue Grama of 77% on the 1080 plots as compared to 36% in the check plots. This data was obtained from graphs by the use of an area calculator.

There was also a marked decrease in the bare area on the 1080 plots. There was an average decrease of 3.6 inches in the length of bare area. All the ant hills studied showed some decrease in the bare area over that recorded in 1961. In 1962, a decrease of 1.6 inches was recorded over that shown in 1961.

Research is now completed and the New Mexico Experiment Station has furnished its recommendations and control projects will be programmed using aerial applications of Myrex B, which has since been proven to be a more active ant killer.

WATER MANAGEMENT - RESERVOIR DEVELOPMENT

Includes the control and/or development of water on the Federal lands.

Water Development

Includes the development of reservoirs, springs, wells, seeps, pipelines, and similar works for livestock and wildlife water.

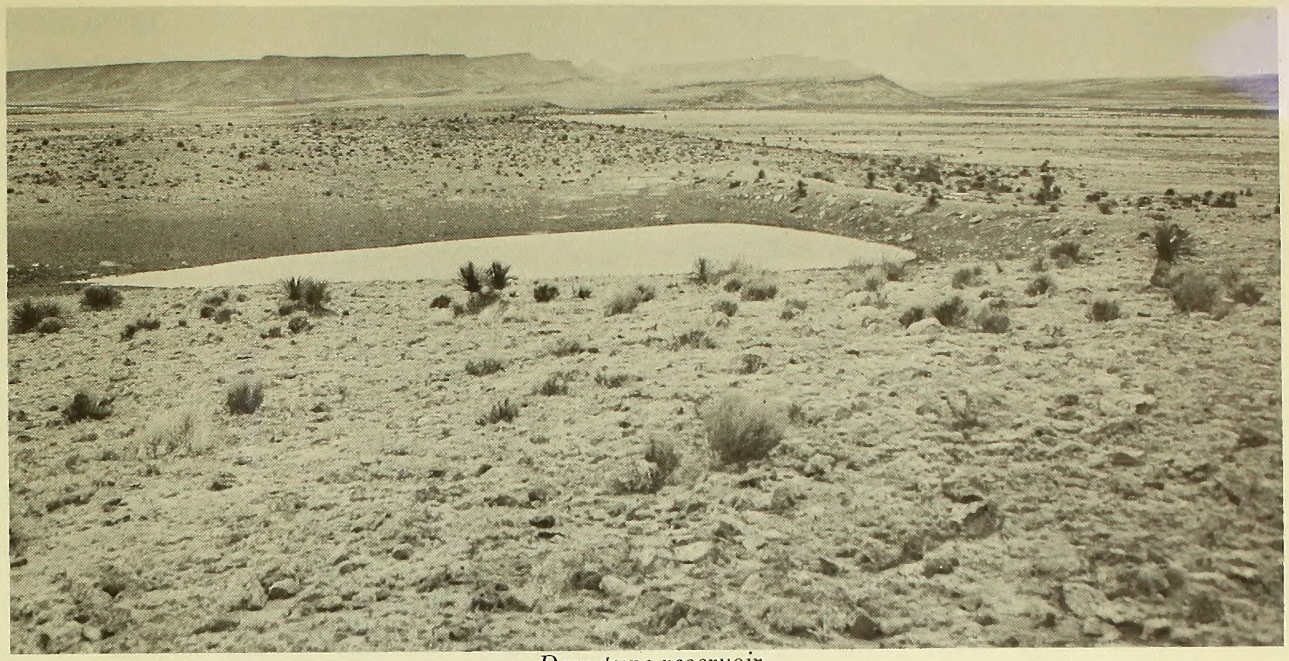
Reservoirs

Includes earthen structures whose primary purpose is to catch and hold water for livestock and wildlife.

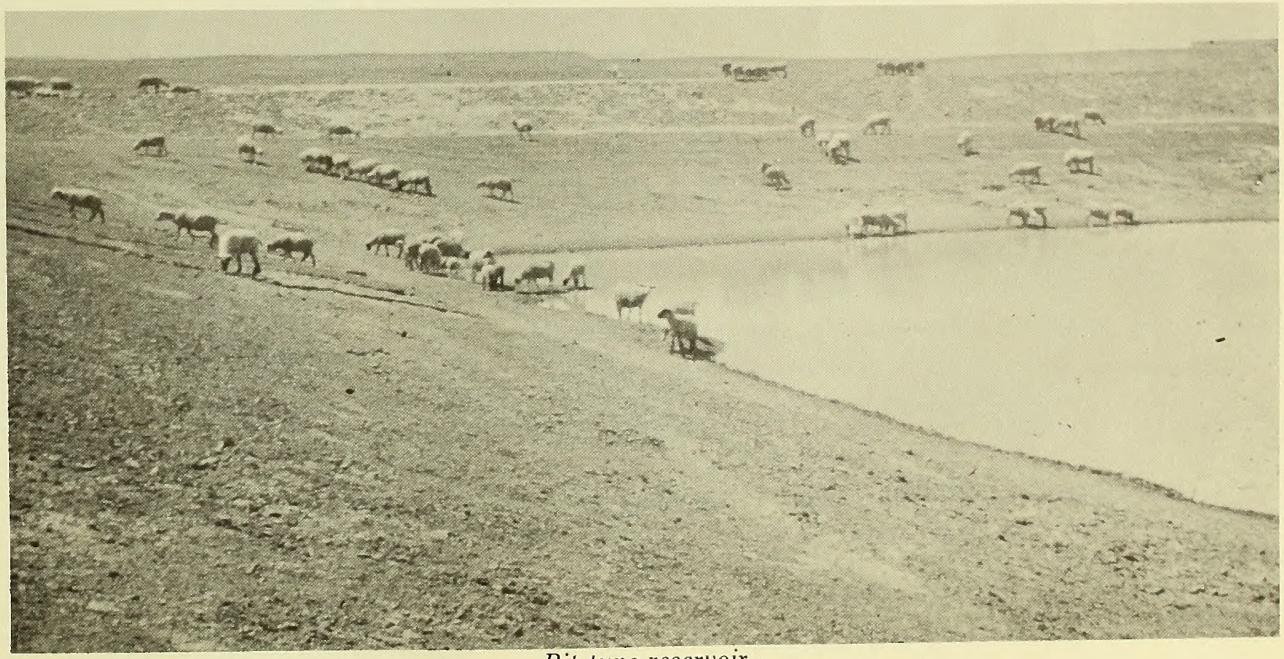
Reservoirs constructed with Bureau of Land Management funds on Federal land are usually built under contract. Dam or pit type tanks may be constructed and will vary in size from 5,000 to 10,000 cubic yards of earth. None of the reservoirs may impound over 10 acre feet unless a water filing is approved, which is in compliance with State law and interstate stream compacts.

All work is done in accordance with standard drawings and specifications.

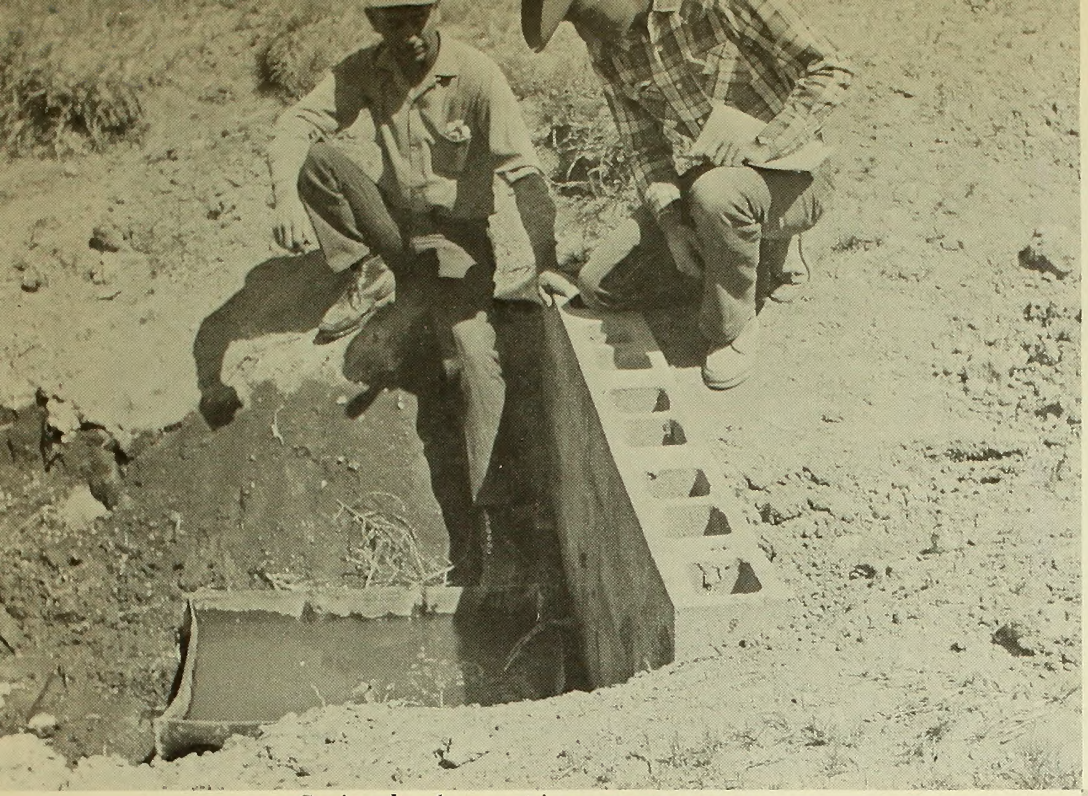
The cost of construction can vary from $.20 to $.30 per cubic yard, making a total of $1,000 to $3,000 per structure. The locations of the structures are determined by joint observation between Bureau of Land Management personnel and the ranch operator considering the use area, drainage area, and engineering properties of the soil.



Dam type reservoir



Pit type reservoir



Spring development increases range use

SPRING AND WELL DEVELOPMENT

Wells

Includes all phases of well development, e.g., drilling, installation of works related to the well, storage tanks, pipelines and troughs.

The development of wells with watering facilities is always a necessary, and important practice. The cost of drilling and casing can vary depending on the depth of water and the size of the hole with an average cost of $8/foot.

In some cases water is needed for the completion of certain erosion and water control structures. When this type of well has served its purpose, the rancher upon whose allotment the well has been drilled may be allowed to use the well for a game and livestock watering.

This practice is again like reservoir development and spring development insofar as cooperation and contributions are concerned.

Spring Development

Includes development of springs and related structures such as pipelines and troughs when installed in the immediate vicinity of the springs.

Springs are extremely important facilities mainly because of the locations. Springs usually occur in steep and rough country which generally inhibit the development of any other water facility. Because of their location in the rougher country, springs are important in distributing livestock and game and increasing utilization by livestock of the higher country.

The work usually involves the encasement of the spring with concrete or cinder blocks to prevent trampling and stopping up of the water flow. In some cases, pipelines may be installed to transport the water to a more desirable or accessible location. At this point, small knee tubs or troughs may be placed. This practice receives good rancher contribution and cooperation.

Well development with watering facilities

OTHER WATER DEVELOPMENT PRACTICES - PIPELINES

Includes storage tanks, pipelines, troughs, etc., when constructed as a separate project.

The development of storage tanks and watering troughs is usually done in connection with well development.

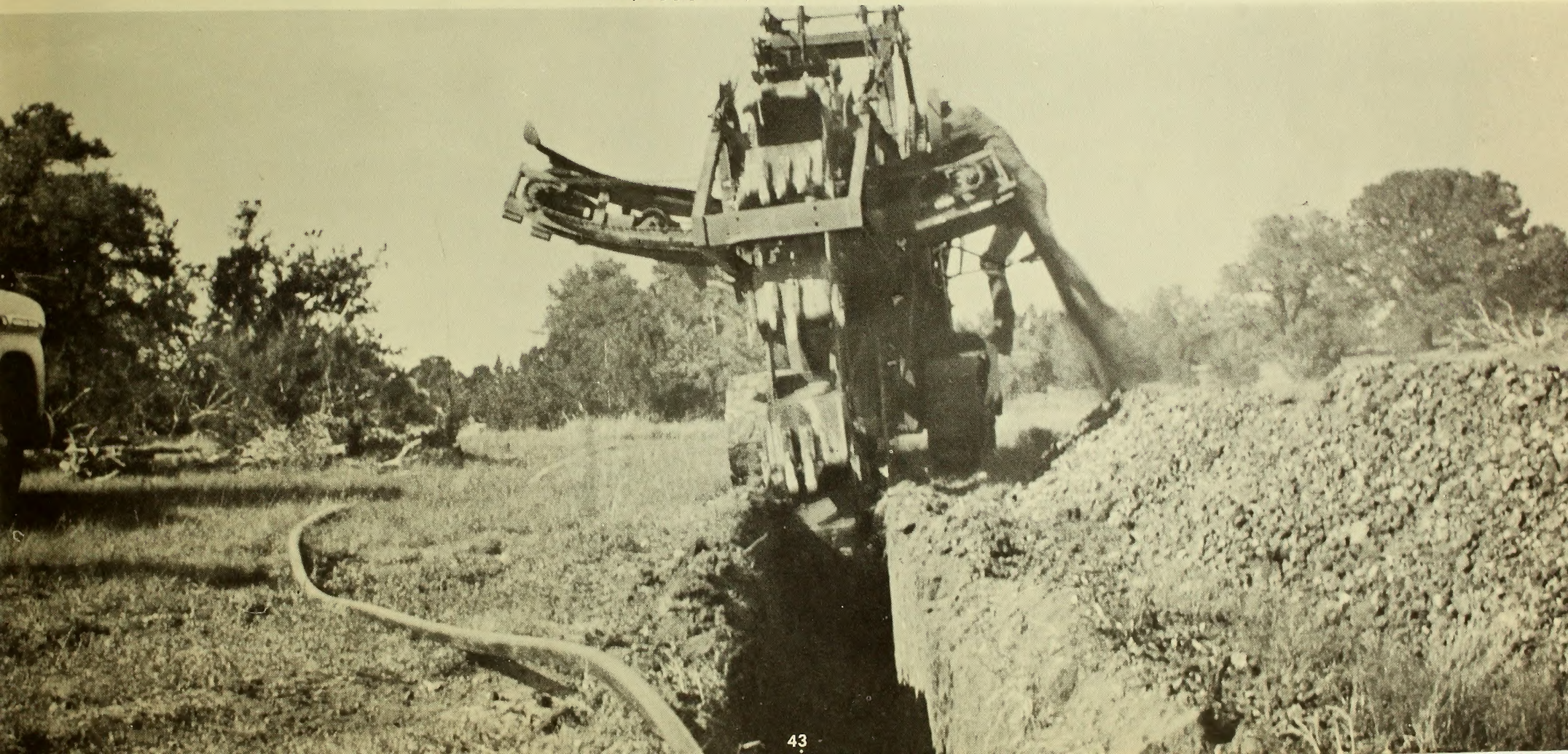
Pipelines

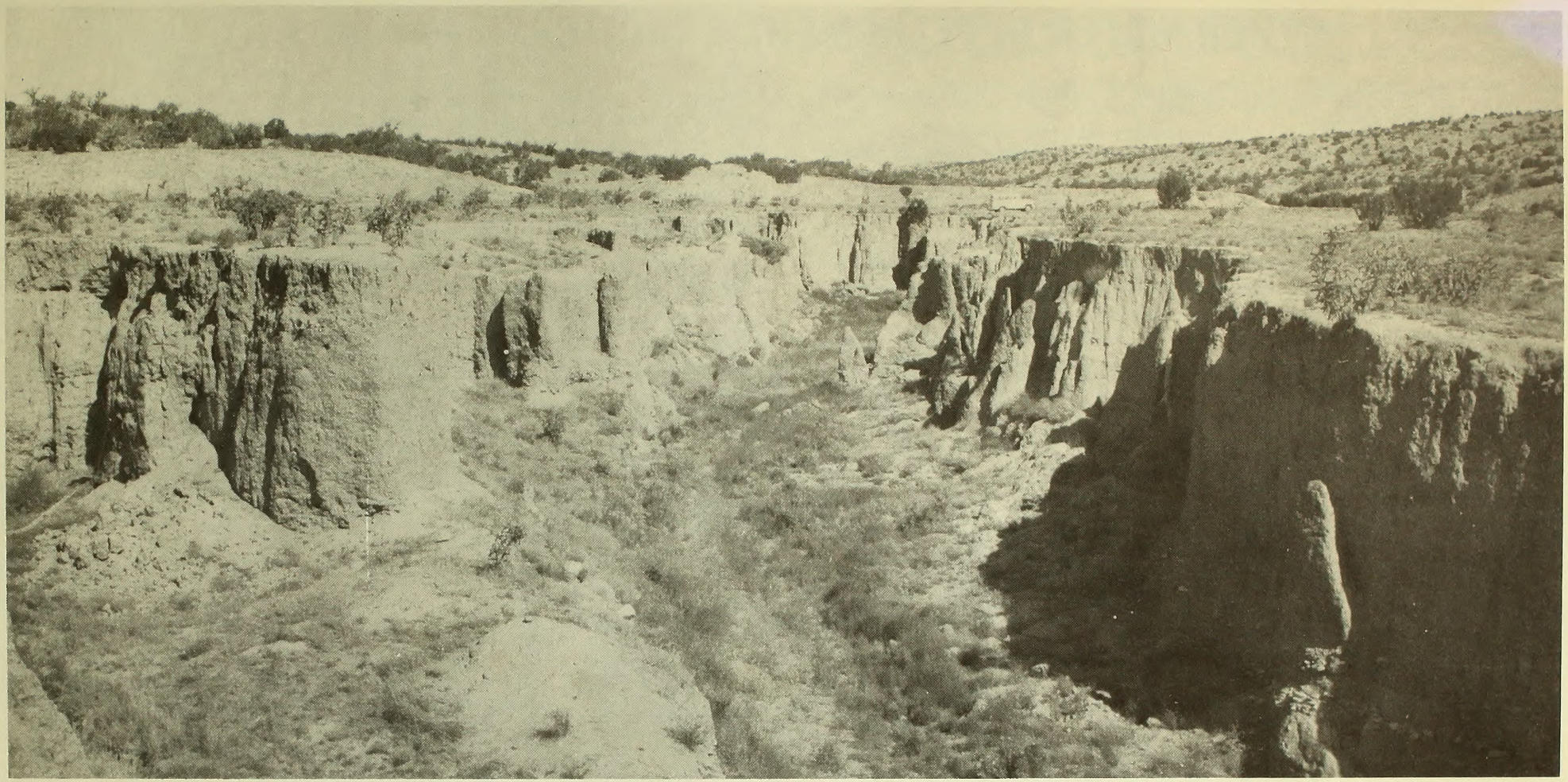
The use of pipelines for the purpose of transporting water for livestock is rapidly becoming an important range management practice. Pipelines provide an extremely economical means of distributing water to previously unused areas within pastures and in other pastures, compared to the cost of reservoir and well development. Water can easily be distributed over the range either from gravity flow or pumping.

Pipe costs usually run about $0.11 per foot. The cooperator may install the pipe and furnish the watering facilities.

So far, the results as evaluated by the Bureau of Land Management have been very satisfactory.

Laying pipeline for new waterings





A severe erosion problem

WATER CONTROL

Includes detention and diversion dams, water spreaders, dikes, canals, and other structures which provide for the temporary storage or diversion of runoff water for the purpose of controlling downstream movement of sediment, stabilizing channels and reducing flow rates.

Erosion is one of the most serious dangers that threatens rangeland today. Many thousand tons of productive soils are washed into lake beds, rivers, streams, etc., by torrential rainstorms, creating heavy runoff. This particular practice is designed to control this type of erosion.

Purpose: The main purpose of diversions and detentions is essentially mentioned above. Productive rangelands are constantly drained of water each year into large gullies and headcuts. These areas then become unstable and extremely vulnerable to erosion. Thus, the erosion process continues and once productive areas become eroded wasteland. By constructing diversions, detentions, and spreaders in adapted areas, the erosion can be curtailed and soils can once again become stable and productive.

Corrugated metal drop structure

DETENTIONS

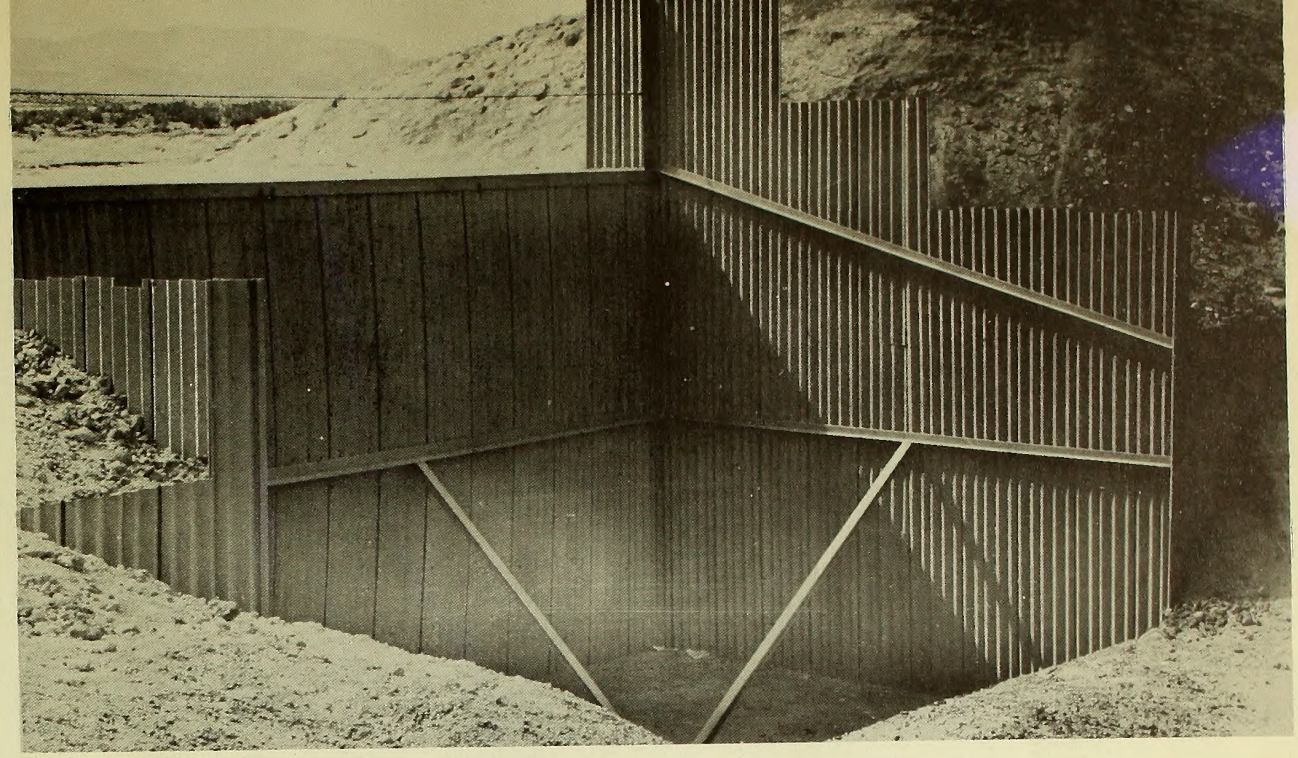
A detention is a structure with fixed outlet works, at or near ground level for the purpose of controlling downstream movement of sediment, stabilizing channels and providing temporary storage of runoff. These are primarily large structures which involve the movement of several thousand cubic yards of earth.

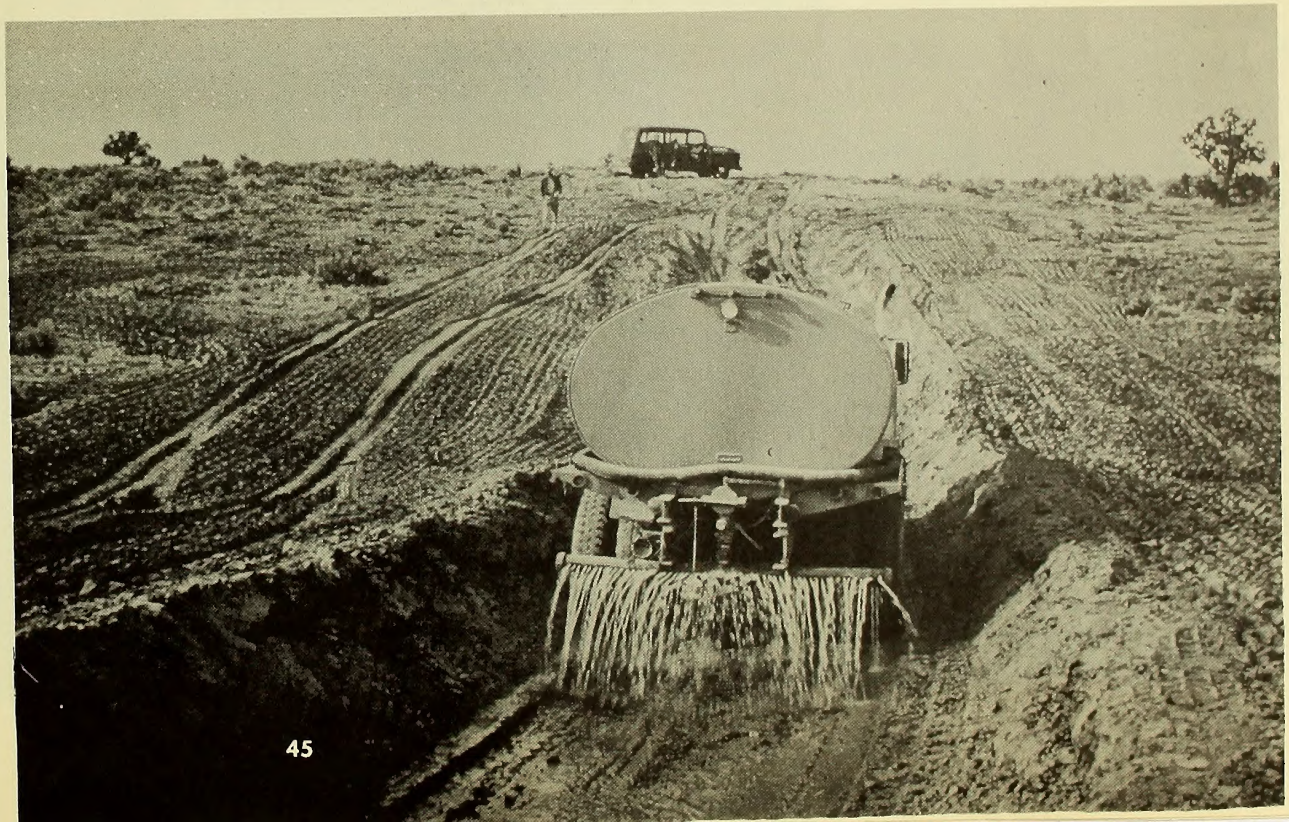
Detentions also include drop structures with wing dikes to control headcut movement.

A desirable site can be above or below a headcut. The site has to possess adequate water storage based on a 50-year storm frequency and sediment storage based on a 25 year storm frequency. The spillway has to be built to have capacity based on the 50-year storm frequency. Undesirable sites may possess numerous deep headcuts in a soil type which will not give necessary compaction or has inadequate foundation qualities where headcuts have already reached the top of a drainage.

Considerably more heavy equipment is needed for this type of work than for other land treatment practices. In addition to heavy earth moving equipment the contractor is also required to furnish watering and compacting equipment. Pipe weeps, drawdown pipes and accessories as may be needed may be furnished, transported and assembled by the contractor.

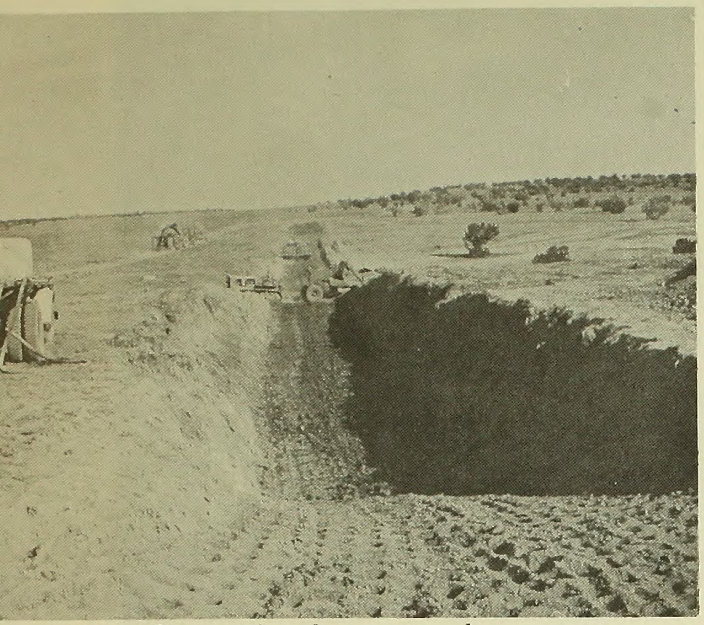
Detention dams can vary considerably in size and are usually measured by the number of cubic yards of compacted earthfill. A 20,000 to 25,000 cubic yard detention dam is considered to be a reasonably small structure while a 40,000 to 45,000 dam would be considered reasonably large. The construction of these dams is done under contract and usually costs from $0.60 to $1.25 per cubic yard, including the outlet works and other incidental operations and facilities.



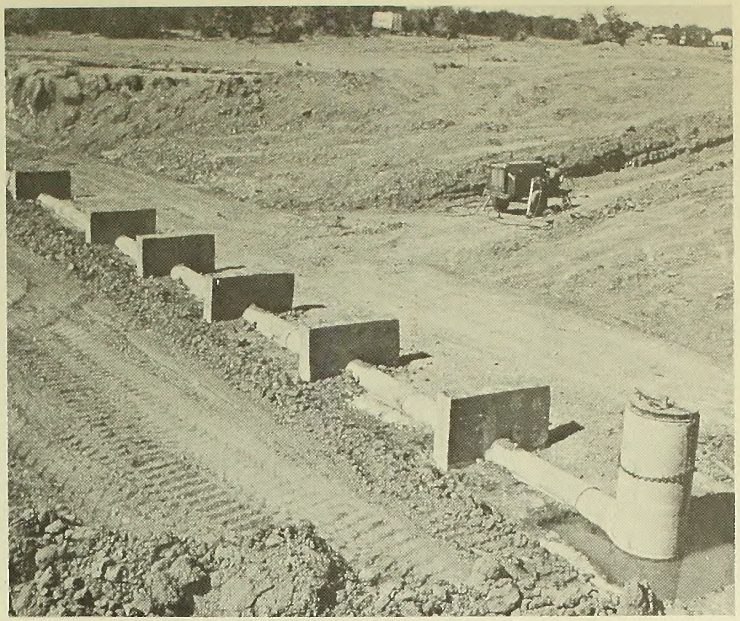


Watering core trench for detention

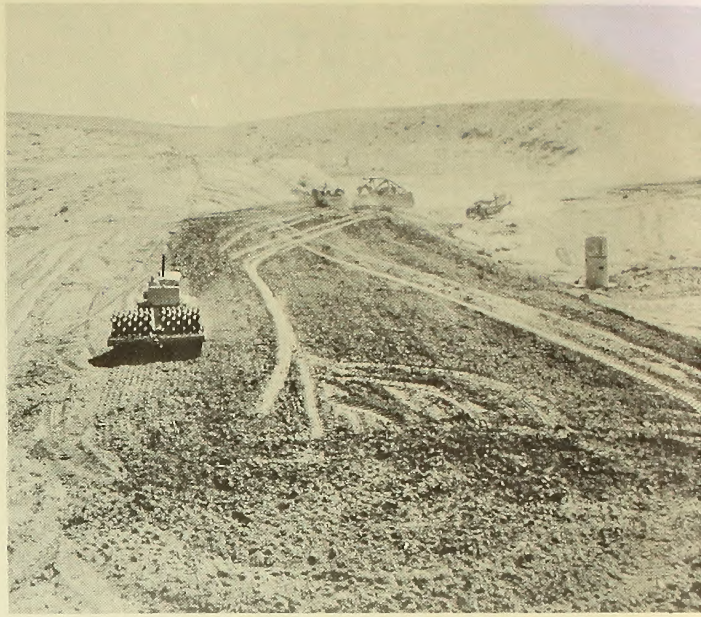
DETENTIONS (Continued)



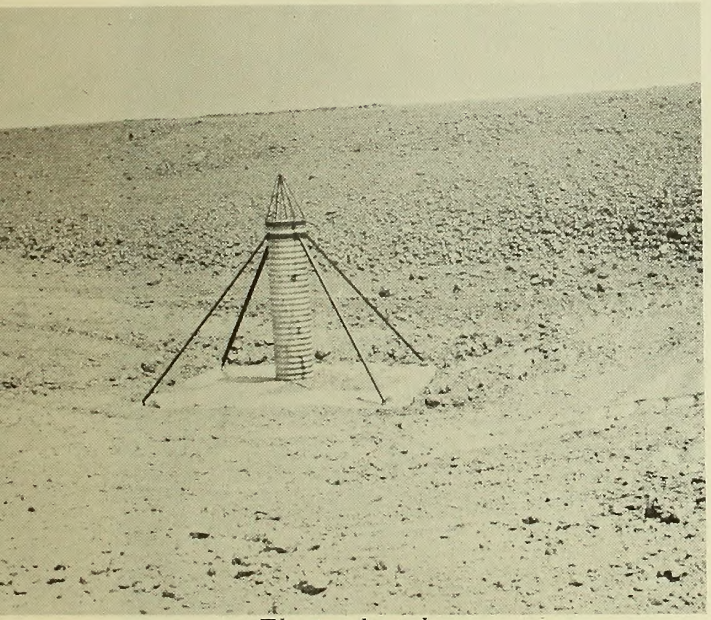
Compacting the core trench



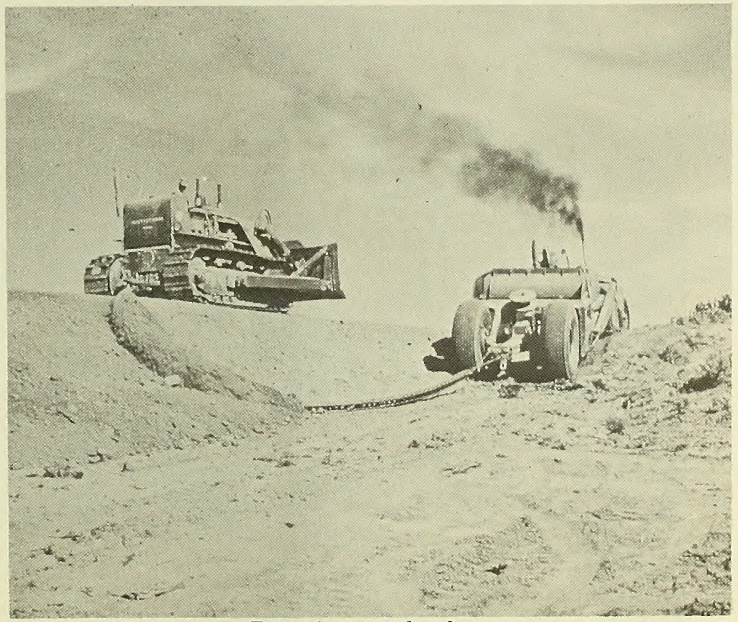
The outlet works



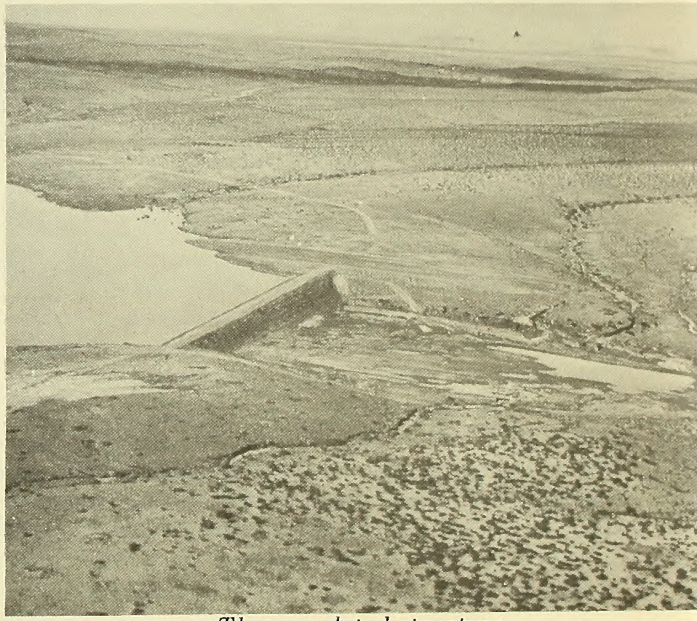
The dam goes up



The trash rack



Dressing up the dam



The completed structure

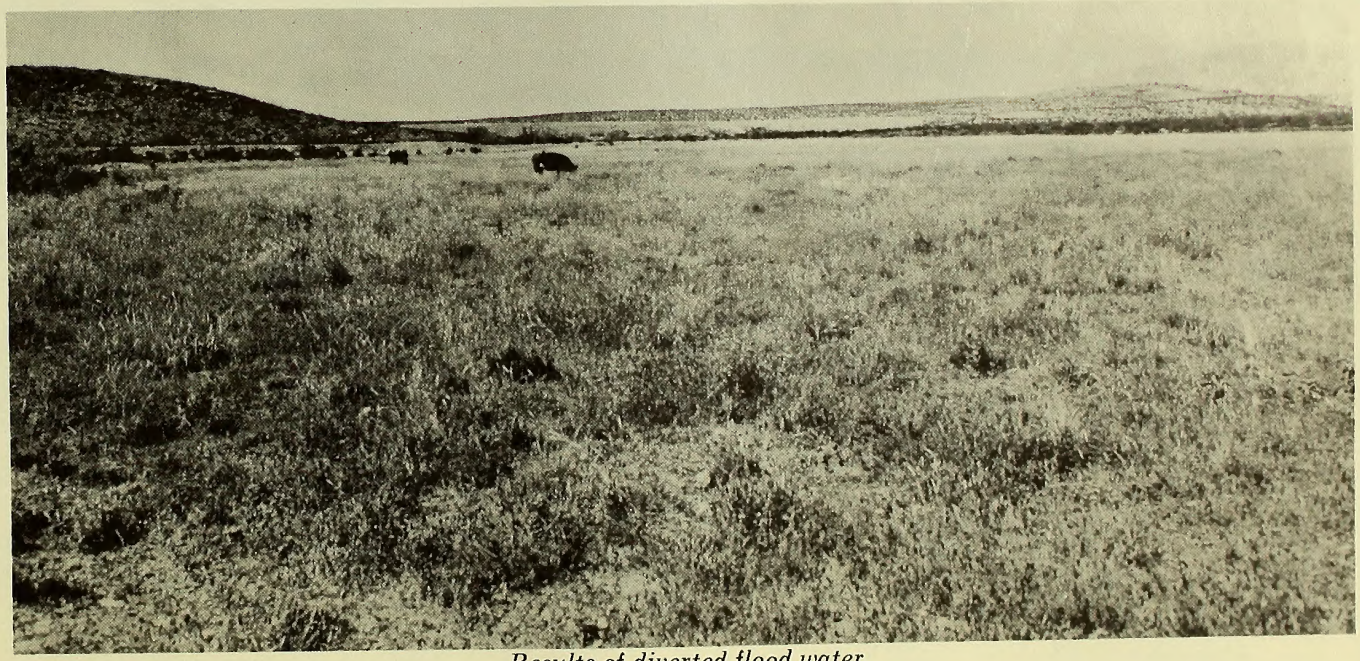
DIVERSIONS

A diversion is any dam or other structure designed for the purpose of raising water out of a defined channel and diverting it to a water-spreading area or into a reservoir.

Diversions require a site where there is a need for moving water from one point to another. This must be done in the same major drainage. Both soil and topography must be adapted to the practice.

Essentially the same equipment is needed for the construction of diversions as is used for the construction of a detention dam. (See Detentions.) The primary difference between the construction of the two is that a diversion dam may not require the fixed outlet works required in a detention dam. Diversions can also vary in size somewhere in the range of 20,000 cubic yards to 40,000 cubic yards. The construction costs of diversion dams vary from $0.50 to $0.75 per cubic yard.

A series of diversions at work



Results of diverted flood water

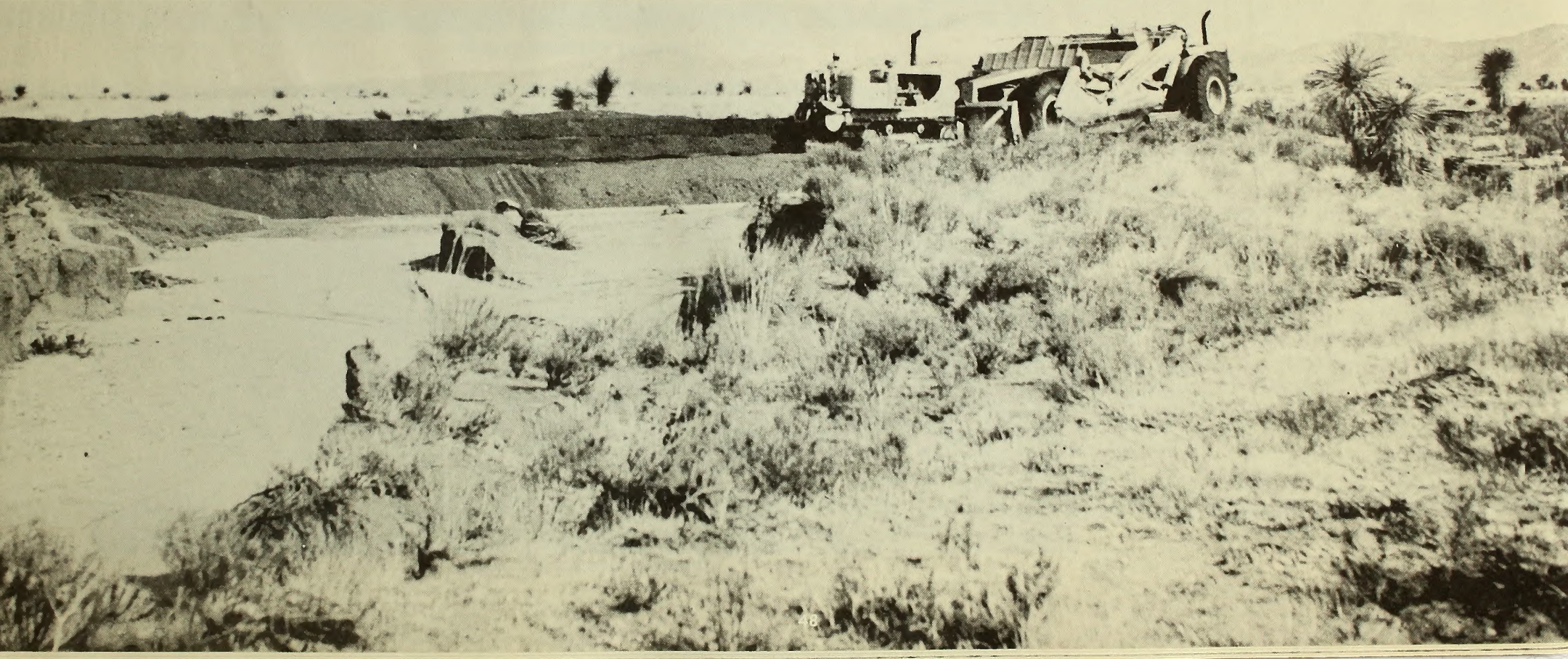
DIKES

Dikes are defined as barriers of earth or other material constructed to control, guide, or deflect water flow or to protect other conservation works from water flow. Because of its design to deflect water, dikes are commonly referred to as spreader dikes.

Dikes may be classed into two categories—diversions and control dikes. Diversion dikes are used to divert water from a gully or stream. This type of dike provides insignificant storage capacity. Control dikes are used to direct the flow of water over selected areas. A system of dikes may be used to direct the flow of water over a specific area and is referred to as waterspreading.

Spreader dikes are usually smaller structures than detention dams and diversion dams and are frequently built in a series. Occasionally, a spreader dike can extend out in length to several miles, but under normal circumstances an average dike will involve approximately 2,000 to 5,000 cubic yards. Weep pipes may be placed in the dikes. Measurement for payment of dike construction is usually based on the number of cubic yards of earthfill complete in place in the dikes as staked on the original ground surface. The cost for the construction of dikes usually runs from $.20 to $0.30 per cubic yard.

A dike under construction



The Marden brush cutter being used to help stabilize arroyo banks

OTHER WATER CONTROL PRACTICES

This includes bank protection, check dams, canals, or other structures whose primary purpose is to stabilize channels and reduce flow rates.

Bank Protection

Bank protection appears to be of increasing importance in recent years, as arroyo banks continue to wash away. In large arroyos or draws, high frequency floods continually undercut the ledges of the draws especially where the draw makes a curve or turn. Consequently, the upper portions of these ledges collapse into the draw and are carried downstream. The Bureau of Land Management is presently planning for the preservation of these banks and should commence work on these in the near future. One experiment on bank protection has been completed whereby a Marden brush cutter (see Brush Control - Sagebrush - Marden brush cutting, for description of equipment) with a seeder attachment was used in an attempt to stabilize the banks on a small draw. No definite results have been received thus far.

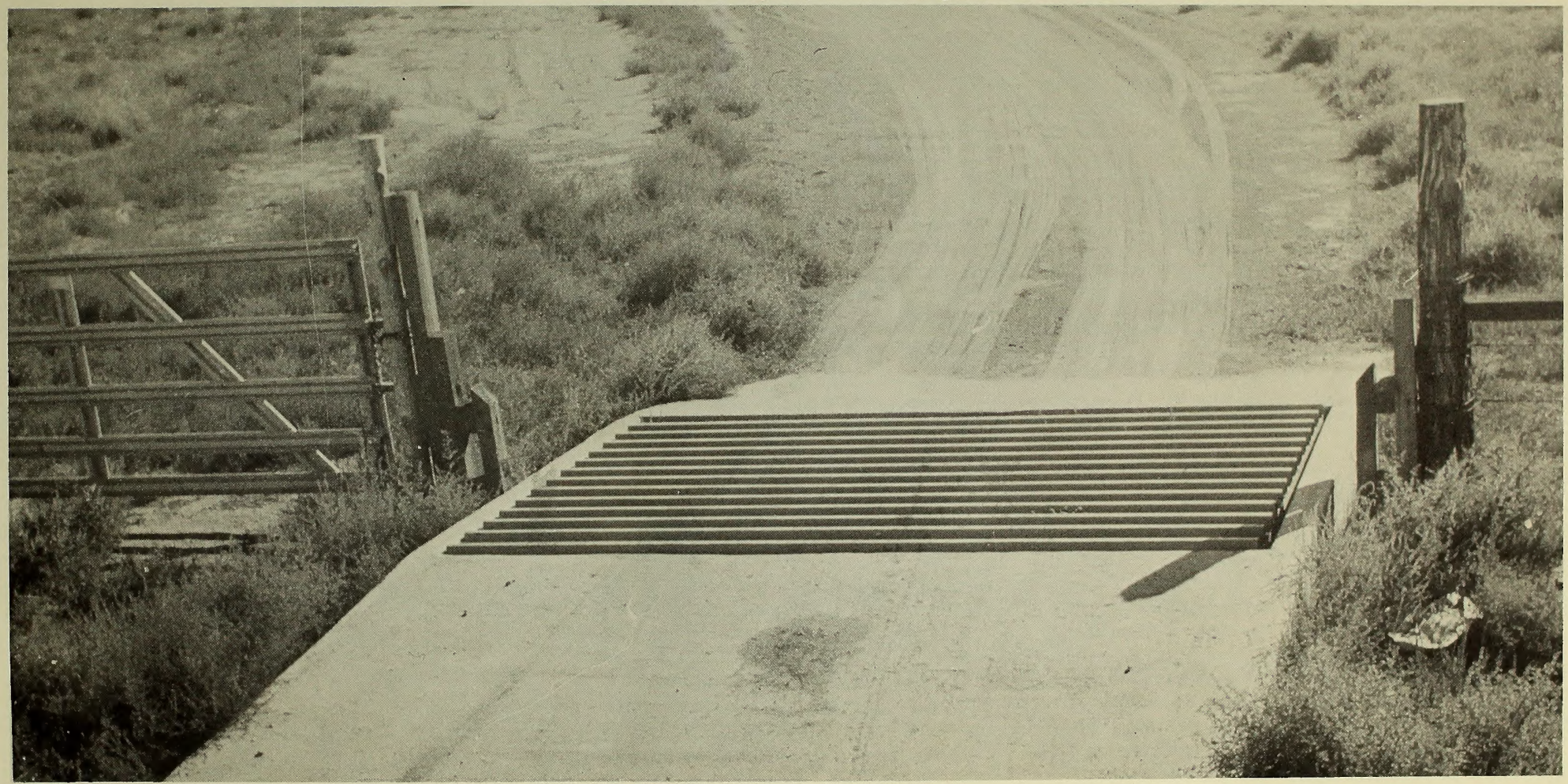
PROGRAM FACILITIES

Includes study plots, stock trails, cattleguards, predator control or other facilities which are necessary for the effective execution of a Resource Development and Conservation Program.

Cattleguards

The cost of the cattleguards is approximately $250. The cost of installing varies with the specification requirements issued by the district office. This cost varies from $250 to $800.

A good installation job of a BLM cattleguard

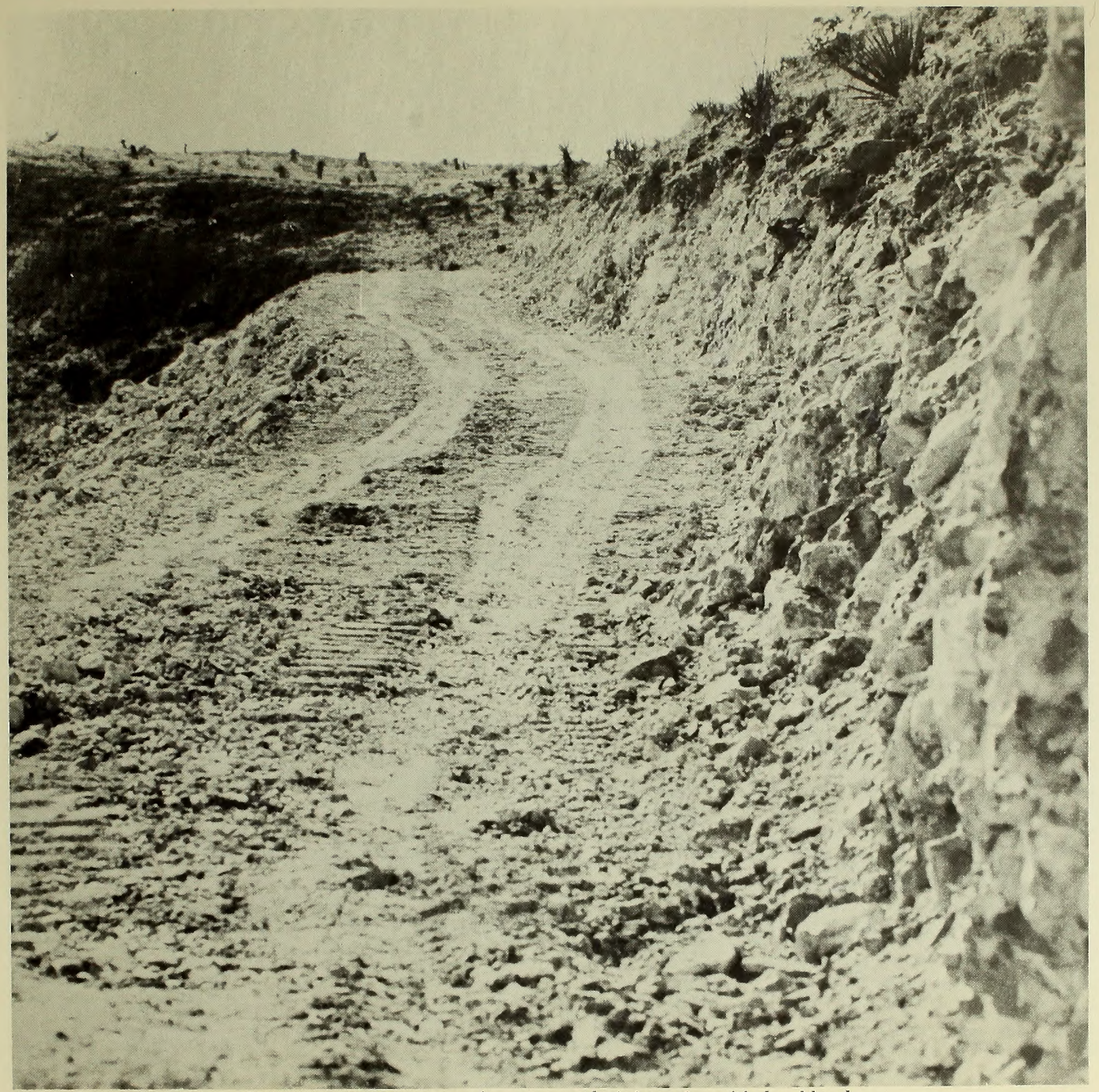


FIRE BREAKS

Includes the development of plans, site location, construction and maintenance of fire breaks or truck trails used to break up continuous fuels, and for access for suppression, and for preventive action.

Several contracts have been let at the district level for such projects. The contracts are awarded on a tractor hour basis and generally do not exceed 100 hours. If more work is required another contract for the completion may be required. Bids received thus far have averaged around $18/hour. The amount of break that can be developed in a 100 hour period varies considerably with the terrain, structure of the soil and the composition and density of the vegetation.

A fire break in oak and juniper



An access road necessary for proper administration of federal lands

PROJECT WORK (ROADS)

Includes force account and contract maintenance work on access roads and physical facilities.

ROADS

The Bureau of Land Management expends a certain amount of funds each year for the maintenance and improvement of roads. These roads are those which are needed for the proper administration of the Federal lands. In most cases, the maintenance of these roads is also of great benefit to the local ranchers, sportsmen and sightseers.

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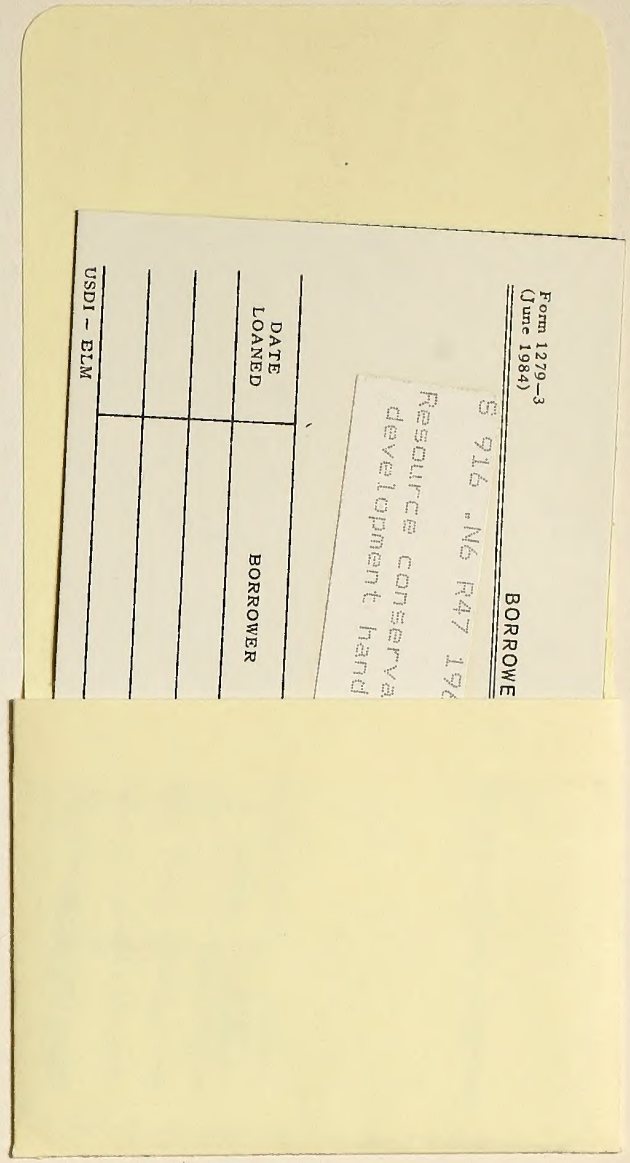

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